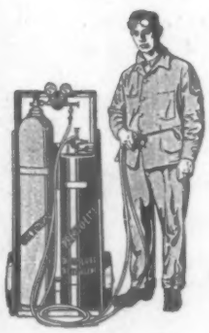
Notice to Readers.—When you finish reading this magazine place a 1-cent stamp on this notice, hand same to any postal employee, and it will be placed in the hands of our soldiers or sailors at the front. No wrapping; no address.
A. S. Burleson, Postmaster General.

The Welding Engineer

Vol. II. Chicago 608 S. Dearborn St. DECEMBER, 1917 $2.00 per year in U. S. $2.50 per year abroad No. 12

Prest-O-Lite
Acetylene Service



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CHICAGO NEW YORK

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K-G Welding & Cutting Co.

556 West 34th St., (INCORPORATED) NEW YORK CITY

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Commercial Acetylene Welding Co.
The Prest-O-Lite Co., Inc.
Universal Oxygen Co.

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Oxweld Acetylene Co.
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Vulcan Process Co.

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Universal Oxygen Co.
Vulcan Process Co.

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Morey Flux & Chemical Co.
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Superior Oxy-Acetylene Machine Co.
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Vulcan Process Co.

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The Welding Engineer
P. F. Willis.

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Torchweld Equipment Co.
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Vulcan Process Co.

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Superior Oxy-Acetylene Mach. Co.
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Vulcan Process Co.

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CRANES (Portable)
H. G. Doran.

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Superior Oxy-Acetylene Machine Co.
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Universal Oxygen Co.

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Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Steel Sales Corp.
Torchweld Equipment Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Vulcan Process Co.

FIREPROOF FLOATING
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Hauck Mfg. Co.
Universal Oxygen Co.

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Superior Oxy-Acetylene Machine Co.

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Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.
Vulcan Process Co.

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Vulcan Process Co.
William C. Adams

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F. A. Hardy & Co.
Vulcan Process Co.

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Hauck Mfg. Co.

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Universal Oxygen Co.
Vulcan Process Co.

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Superior Oxy-Acetylene Machine Co.
Vulcan Process Co.

The Growth of Oxy-Acetylene Welding and Cutting and the Increasing Demand for Davis-Bournonville Apparatus

A Year Ago we said—

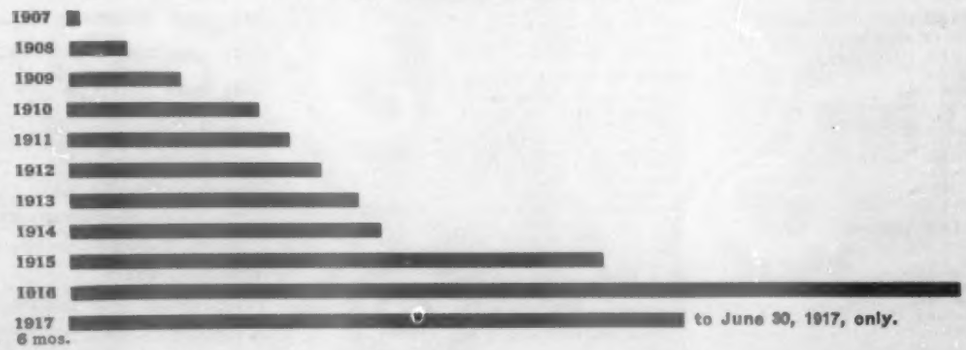
"The growth of Oxy-Acetylene Welding and Cutting in the United States is shown by the increasing use of Davis-Bournonville apparatus, which is inseparably associated with the development and success of the oxy-acetylene industry in this country.

"Ten years ago the process was unknown in the United States. Today it forms one of the great industries of the country, with its requirements for acetylene, oxygen and efficient apparatus.

"The Davis-Bournonville Company obtained the United States patents for the independent positive-pressure type of welding torch (mixing the gases in an interchangeable tip or nozzle) in 1906—basic principles which have been retained in the D-B torch because of their proven superiority through ten years of development, improvement and the most successful operation.

"There is more Davis-Bournonville welding and cutting apparatus in successful use in the United States than of any other make, and the prominent concerns which have established the greatest success with this process have large installations of D-B apparatus, with from ten to one hundred or more torch units, and from one to six of the largest acetylene generators."

Today—The increasing use of the oxy-acetylene process for welding and cutting and of Davis-Bournonville apparatus are parallel and are graphically shown by the sales of "Davis Apparatus" as charted below:



"Davis Apparatus" Leads the World in Range, Efficiency and Number of Successful Users. Write for bulletins and information showing why it is used by the largest steel mills, foundries, ship-yards, locomotive and car builders, U. S. Navy Yards and government works, mines, sheet metal working factories, tube and barrel welders, scrap yards, and in hundreds of small repair shops and garages.

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Bermo Supply Co.
Buffalo Dental Mfg Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.
Vulcan Process Co.

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Alger Supply Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Mach. Co.
Vulcan Process Co.

OXYGEN (Compressed in Cylinders)
Burdett Oxygen Co.
The Linde Air Products Co.
Swift & Co.
Universal Oxygen Co.
Vulcan Process Co.

OXYGEN CYLINDERS

PIPE WELDING
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PRESSURE GAUGES
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Bastian & Blessing Co.
Bermo Supply Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
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Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Vulcan Process Co.

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REGULATING VALVES (Acetylene)
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Bermo Supply Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
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K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
The Prest-O-Lite Co., Inc.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Vulcan Process Co.

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Carbo-Hydrogen Co. of America

REGULATING VALVES (Hydrogen)
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The Bastian-Blessing Co.
Bermo Supply Co.
The Prest-O-Lite Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
Universal Oxygen Co.
Vulcan Process Co.

REGULATING VALVES (Oxygen)
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American Welding Co.
Bermo Supply Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Vulcan Process Co.

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Thomson Electric Welding Co.

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THERMIT WELDING
Goldschmidt-Thermit Co.

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Carbo-Hydrogen Co. of America

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Buffalo Dental Mfg. Co.
General Welding & Eq. Co.
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Hauck Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
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Vulcan Process Co.

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Bermo Supply Co.
Davis-Bournonville Co.
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General Welding & Eq. Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Messer Mfg. Co.
Welding Supply Co.
K-G Welding & Cutting Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Vulcan Process Co.

TORCHES (Oxy-Acetylene Welding)
American Welding Co.
Bermo Supply Co.
Davis-Bournonville Co.
The Evieth-Lindsay Co.
General Welding & Eq. Co.
The Harris Calorific Co.
Messer Mfg. Co.
Welding Supply Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.
Vulcan Process Co.

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American Welding Co.
Bermo Supply Co.
Davis-Bournonville Co.
The Evieth-Lindsay Co.
Messer & Co.
Welding Supply Co.
General Welding & Eq. Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Alexander Milburn Co.
The Imperial Brass Mfg. Co.
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Vulcan Process Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

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Bermo Supply Co.
The Evieth-Lindsay Co.
Messer Mfg. Co.
Welding Supply Co.
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Davis-Bournonville Co.
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The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
The Alexander Milburn Co.
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Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

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Superior Oxy-Acetylene Machine Co.
Vulcan Process Co.

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Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Vulcan Process Co.

VALVES (For Oxygen Cylinders)
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Universal Oxygen Co.
Vulcan Process Co.

WELDING (Electric Resistance-Custom Work)
Thomson Electric Welding Co.

WELDERS' GOGGLES
William C. Adams
Chicago Eye Shield Co.
F. A. Hardy Co.
Vulcan Process Co.

WELDING (Oxygen for)
The Linde Air Products Co.
Universal Oxygen Co.
Vulcan Process Co.

WELDING RODS
Bierman-Everett Fdy. Co.
Page Woven Wire Fence Co.
Steel Sales Corp.
Vulcan Process Co.

ALPHABETICAL INDEX TO ADVERTISERS

A
William C. Adams 39
Alger Supply Company 10
Aluminite Mfg. Co., Inc. 41
American Oxygen Co. .....
American Welding Co. 42
Ampco Rolling Mills Corp. 37
Anti-Borax Compound Co. 39

B
The Bastian-Blessing Co. 8
Bermo Supply Co. 42
Bierman-Everett Fdy. Co. 41
Buffalo Dental Mfg. Co. 9
Burdett Oxygen Co. 35

C
Canada Carbide Sales Co. 15
Carbo-Hydrogen Co. 17
Chicago Eye Shield Co. 11-41
Commercial Acetylene Welding Co. Back cover
Cortland Welding Compound Co. 39

D
Davis-Bournonville Co. 5
M. Keith Dunham 42

E
The Evieth-Lindsay Co. 42

G
General Welding & Equipment Co. 11
General Electric Co. 16
Goldschmidt Thermit Co. 43

H
The Harris Calorific Co. 17
Henderson-Willis Welding & Cutting Co. 37
F. A. Hardy & Co. 39
Hauck Mfg. Co. 3

I
Ideal Face Shield Co. 39
Imperial Brass Mfg. Co. 33-41
International Oxygen Co. 37

K
K-G Welding & Cutting Co. 3

L
The Lincoln Electric Co. .....
Linde Air Products Co. 18

M
Messer Mfg. Co. 41
The Alexander Milburn Co. 3
Morey Flux & Chemical Co. 41

N
National Carbon Co. 43

O
Oxweld Acetylene Co. 2
Oxweld Railroad Service Co. 3

P
Page Woven Wire Fence Co. 13
Prest-O-Lite Co., Inc. ..... Front cover

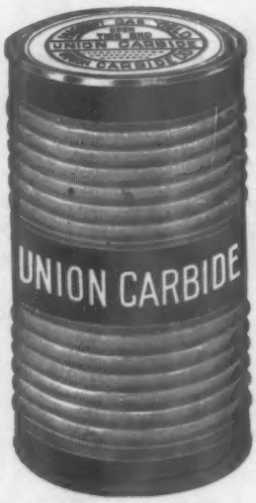
S
Superior Oxy-Acetylene Machine Co. 42
Swift & Co. 11
Steel Sales Corporation 13

T
Torchweld Equipment Co. 13
The Thermalene Co. 10
Thomson Electric Welding Co. 10

U
Union Carbide Sales Co. 7
United States Welding Co. 42
Universal Oxygen Co. 9
U. S. Gauge Co. 8

V
Vulcan Process Co. 17

W
Westinghouse Electric & Mfg. Co. 42
P. F. Willis 42



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UNION CARBIDE

"World's Best Quality—Highest Gas Yield"

For Oxy-Acetylene Welding Plants

Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

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Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—826-836 Fifth St.
San Francisco—Kohl Building.
COLORADO
Denver—Nineteenth and Wazee Sts.
Victor—Third and Diamond Sts.
CONNECTICUT
Hartford—412 Trumbull St.
DISTRICT OF COLUMBIA
Washington—Maryland Ave. and 9th St., S. W.
FLORIDA
Jacksonville—106 E. Forsyth St.
Tampa—413 Tampa St.
GEORGIA
Atlanta—Cor. Haynes and Rhodes Sts., P. O. Box 1594.
Savannah—Ogeechee Canal, South of Bay St., P. O. Box 78.
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Indianapolis—110-112 S. Alabama St.
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Des Moines—117-119 Fifth St.
Dubuque—8th and Washington Sts.
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Portland—202 Commercial St.
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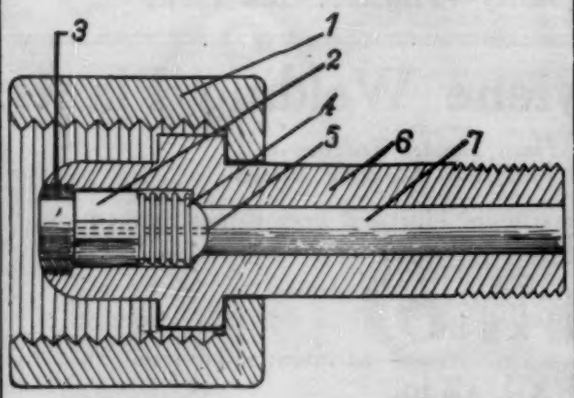

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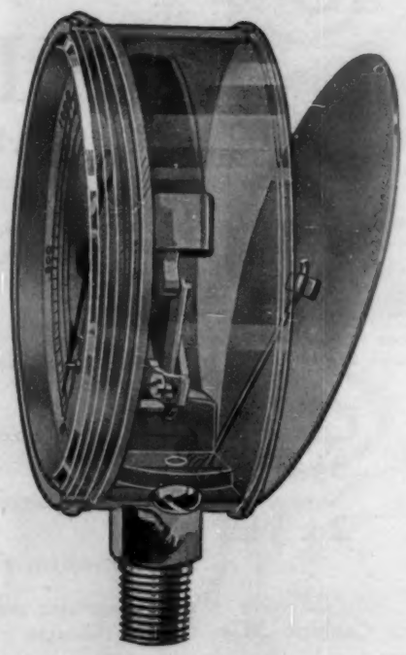

Patented July, 1916

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for

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"We Need an Experienced Welder"

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"Today we are in need of an experienced welder. We want men who can earn their money. The writer has been at the game a long time and has reached the point where he is through teaching men the business. These men are an expense for the first six months, during which time they do not earn their salaries. As soon as they get to the earning point, they expect a big salary, and on account of carrying them through a losing period, we do not feel that we can afford to pay them a big salary, with the result that some competitor offers them a salary which the trainer is not justified in paying. We now want **experienced** men, who can start right out and the very first day earn his salary and a little better, and we think that there should be some central point where such requirements could be filled."

The Welding Engineer has filled many positions like this one and will fill many more. If you are a capable welder and would consider this position, or one like it, we would like to keep in touch with you. Fill out the following application blank and mail it to L. B. Mackenzie, 608 S. Dearborn St., Chicago. The information will be considered confidential and when we hear of a vacancy we will put you in touch with it.

L. B. Mackenzie, Date.....19....
608 S. Dearborn St., Chicago.

I would consider the offer of a position. I give you in confidence the following information about myself.

Name .....

Street and No.....

City .....State.....

Age .....Married or Single.....

I am employed by.....

Position wanted.....

Location desired.....

Salary expected.....

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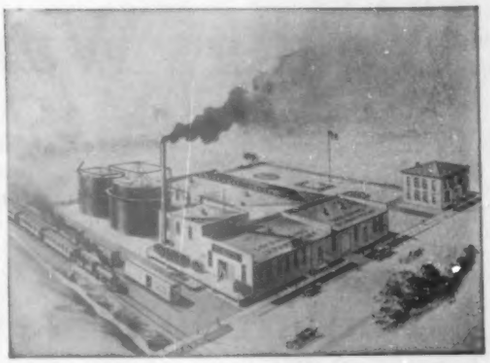

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The two most essential points in welding are:

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SECOND: The saving of gas by preheating your work for the oxy-acetylene flame.

The first is under your control in the use of the oxy-acetylene apparatus you have selected.

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Welders Wanted for the Army

Skilled men in a great many different lines of trade are urgently needed at this time. Your Uncle Sam needs the co-operation of skilled specialists, especially welders. Automobile trucks must be kept in service, ambulances must not stand idle because of broken parts—work for the welder. A big railroad system, transporting our boys and their supplies, ammunition, etc., must not suffer from idle locomotives or other equipment, when a good welder could overcome the difficulty. Back of the lines big industrial plants must be kept in operation and welders must do their part.

Become a Non-Commissioned Officer

Men who enlist in the Ordnance Corps now (the "Army behind the Army") and possess proper qualifications will be made non-commissioned officers later.

What the Ordnance Corps Is

The Enlisted Ordnance Corps, National Army, into which the Ordnance Enlisted Reserve Corps has been merged, is charged with the supply, maintenance and repair of all cannon and artillery vehicles and equipment; all machines for the service and maneuver of artillery; all small arms, ammunition, harness, motor trucks, motor cycles, tractors and railroad cars; in fact, it is the Army behind the Army commonly known as "Service of the Rear."

Type of Men Wanted

There is a place for practically every man who knows a trade in the Enlisted Ordnance Corps. Machinists, mechanics, plumbers, painters, carpenters, canvas workers, auto mechanics, saddlers, blacksmiths and wheelwrights are especially needed at this time.

Applicants must be between 18 and 40 years, citizens or declarants, and be able to speak, read and write the English language, should have no absolute dependents, and must be able to pass a physical examination conforming to that prescribed for the Regular Army.

Place and Type of Service

If accepted for enlistment, men will ordinarily be sent to an arsenal school for a period of instruction, on completion of which they will be assigned to detachments, units or organizations, with ultimate service abroad. Previous military training, while preferable, is not essential, as men will continue the work which they pursue in civil life.

Pay and Grade

In view of the importance of their work a large number of men will serve as non-commissioned officers. Original enlistment is required as private, but later courses of training or special qualifications quickly lead to higher grades. Pay ranges from $30 to $97.20 a month, depending upon demonstrated ability and place of service. Men enlist for duration of war only.

Free quarters, rations, clothing, bedding, medical attendance, etc., are provided.

Relation to the Draft

Men registered under the Selective Service Law may voluntarily enlist prior to the posting of their names by their Local Boards. No man who has been called to appear for physical examination is eligible for enlistment in any branch of the military service. In case such men do enlist, the department under which they have enlisted will be requested to discharge them and direct them to report to their local boards.

How to Enlist

Get application blank by writing to Chief of Ordnance, Enlisted Personnel Division, Washington, D. C. Fill it out, return to Chief of Ordnance, and if there is an opening for you at the time, authorization will be sent you to enlist at the nearest recruiting station, and if accepted there, free transportation will be provided to place of service.

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This goggle, while primarily designed for use under extreme dust conditions, has attained great popularity as a Welder's goggle.

BECAUSE

—the cups are made of aluminum, giving LIGHT WEIGHT.
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Welding has been so widely featured for repair and patching work that many people never think of it as a manufacturing process.

As a matter of fact, Lincoln Arc Welders used in manufacture of metal products are frequently making even greater savings than in repair work.

Welding cast iron attachments to a sheet steel tank with Lincoln Arc Welder. Net saving 62% over former methods.

Lincoln Arc Welders

are especially adapted to fabricating iron, steel and other metals—welding seams, fastening on attachments—joining of parts—in fact, any work of this nature on which speed and economy count. The heat from the Lincoln Arc can be concentrated on a small surface, giving a clean looking job and preventing the warping or buckling usually encountered in gas welding.

The operation of the Lincoln Welder can be learned by any intelligent workman in two or three days. Once broken in, he can do welding jobs at lower cost than with any other equipment or process. This we prove in your own shop. Our Welding Engineer will gladly inspect your plant and product for welding possibilities—at no cost to you.

WHAT OTHER MANUFACTURERS WELD

Boiler Seams
Boiler Tubes (to sheets)
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Auto Axle Housings
Steel Cars and Parts
Cement Kilns
Steel Tank Work
Automobile Frames
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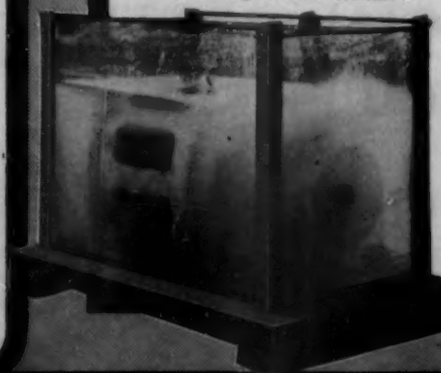
Wrought Iron Grilles
Grave Vaults
Pipes and Fittings
Wheel Rims
Steel Shapes
Steel Pulleys
Steel Barrels

Anything which requires joining of materials.



Standard Lincoln Motor Operating Under Water.

Write for Welding Bulletin No. 50-L

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This is the only complete book on the "Why" and "How" of Welding

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CONTENTS

CHAPTER I.—APPARATUS KNOWLEDGE.
Oxygen Supply—Care of Oxygen Cylinder—Acetylene Generation—Care of Generator—Regulators—Care of Regulator — Creeping Regulators — Gauges—Care of Gauges—Welding Torch—Care of Welding Torch—Effects of Heat—Hose and Goggles.

CHAPTER II.—SHOP EQUIPMENT AND INITIAL PROCEDURE.
Preheating Agencies—Welding Table—Location of Welding Outfit—Starting the Welding Outfit—Adjustment of Flame—Principle of Welding—General Welding Knowledge—Welding Rods and Fluxes—Choice of Tip—Expansion and Contraction.

CHAPTER III.—CAST IRON.
Simple Welding—How to Hold the Flame—Hard Cast Iron—Pin Holes and Blow Holes—Lug on Cylinder—Water Outlet—Cylinder Welding—Compression Head—Finishing and Testing—Scored Cylinders—Cylinder Parts—Fly Wheels—Pistons—Crank Cases — Babbitted Bearings — Valve Guides—Preserving Threads—Conclusion of Cast Iron.

CHAPTER IV.—ALUMINUM.
Use of—Welding Knowledge—Puddle System—Flux System—Comparison of Systems—Welding Rod—Preparation of the Weld—Inlet Manifold—Arm of Crank Case—Welding the Arm Without Taking Out the Motor—Break in the Body of Case—Welding Cold—Wrong Method of Setting Up—Lug or Boss Welding—Preheating the Case—Gas Preheating Flame—One Side or Both—Collapse of Weld—Broken Bearings—Direction of Welding—Shrinkage Cracks—Missing Parts—Finishing—Die Moulded Castings—Body—Other Parts.

CHAPTER V.—STEEL.
Welding Knowledge—What the Flame Does to Steel—The Welding Rod—Simple Welding—Position of Flame—Reinforcing the Weld—Frame Welding—Lengthening the Chassis—Tube Housings—Worn Parts—Gear Welding — Case Hardening — Light Metal Welding—Gasoline Tank—Welding Adjacent to Rivets—Shaft Welding—Construction of Parts.

CHAPTER VI.—MALLEABLE IRON, COPPER, BRASS, BRONZE.
How to Detect Malleable Iron—Brazing Malleable Iron—Rear Housing—Reinforcing the Brass—Brazing Tube to Housing—Building Up Worn Parts—Copper—Brass and Bronze—Silver Soldering.

CHAPTER VII.—CARBON BURNING AND OTHER USES OF OXYGEN AND ACETYLENE.
Principle of Carbon Burning—Method of Operation—Lead Burning—Soldering—Case Hardening—Heating Uses.

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Oxygen Consumption—Dissolved Acetylene Consumption—Torch Consumption Test—Acetylene Generator Consumption—Cost Card—Conclusion.

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THE WELDING ENGINEER

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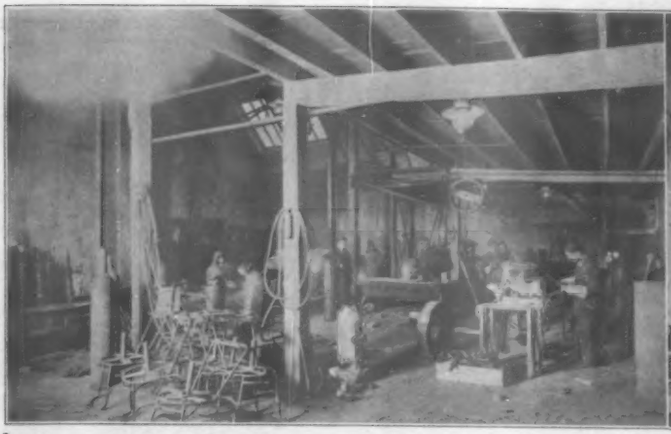
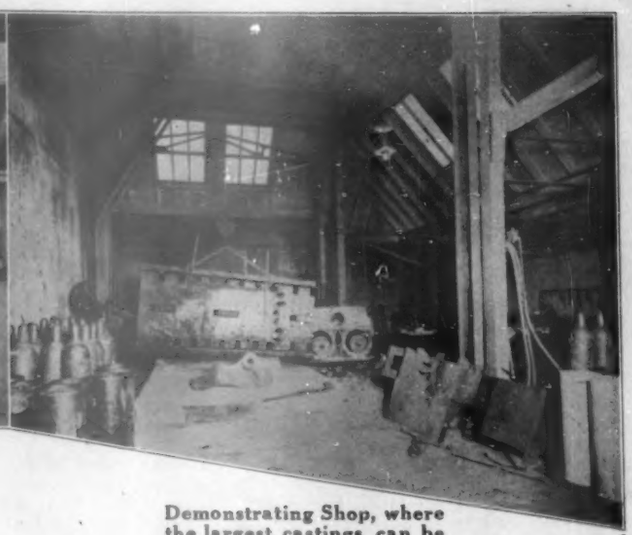


Another view of Demonstrating Shop, showing a multitude of small work



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Linde Service met that situation by planning and rushing to completion two brand new manufacturing units in that district and by filling all orders in the meantime through relief shipments of cylinders from other warehouse stations in the Linde coast to coast chain of sixty-four links.

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BRITISH WELDERS *and the* WORLD WAR

An Account of the Part Our English Cousins and Brothers in Arms Are Playing in the Big Conflict

By Frank Mynott

London Correspondent, The Welding Engineer

THE marvelous work of the British welder in increasing the efficiency of the British war machine is well set forth in the following article from the London representative of *The Welding Engineer*. Writing from London in October—our correspondent—a well-known Anglo-Canadian journalist, says:

"I called today at the headquarters of the British Acetylene Welding Corporation, in London, to learn something of the war-time activities of our trade in the British Isles. I need not attempt to describe to you the marvelous manner in which Britons of both sexes of all ages and all sizes have rallied round the old flag. Your able American newspaper correspondents have already placed on record in thousands of columns full details of the mobilization of British man power for both military and industrial purposes. But nowhere either in Britain or in America has anything been published that gives even the merest glimpse of the British welder on war work. Mr. Lucas, the corporation's secretary, frankly confessed that although everywhere there had been a marvelous extension of the welding industry and a much greater official and governmental recognition than hitherto, no attempt had been made in any quarter to collate authentic details and present to the world anything like a historic survey of the industry's efforts. For one thing not all the welding trading companies belonged to the corporation or any other trade organization, and therefore no means were ready at hand that would furnish reliable data. 'But,' said Mr. Lucas, 'there is unmistakable evidence on all hands of the enormous extension of our industry, not the least important of which is in connection with the manufacture of British aeroplanes. In this branch of war activity alone thousands of women and girls are daily engaged, many of them in welding work of the highest importance.

"'The welding corporation,' said Mr. Lucas, 'plays no small part in securing the efficiency of British workers. In all the big centers of population, like London, Newcastle, Glasgow, Portsmouth, Leeds, Birmingham, there are weld-

C. W. BRETT,
Managing Director and Gen'l Mgr., Barimar Ltd., London, England.

H. E. LAMPLOUGH,
Works Director, Barimar Ltd., London, England.

ing schools established under the supervision of the corporation, and to the successful students, after competitive examinations, certificates of efficiency are presented. In this way, there is maintained a steady flow of capable welders. Of course, welders' wages, like all other salaries, have gone up considerably in Britain since the war set in, but it must not be supposed that they anywhere approach what to us are the princely sums of American works. The London men's wages have gone up from 20 cents per hour in prewar days to, in some cases, 40 cents, though the general level is lower than this. In this, as in so many other directions, we have traveled far. *Now*, whether your engineering trading corporation be "controlled" by the government here as many thousands of such firms are all over the kingdom the government committees largely fix the wages. We have what is called a "Wages of Production Committee," which, with or without complaint from workers for individual firms, from time to time meets and awards new increases to cover the rising cost of living. The awards of the committee are to all intents and purposes *laws*. Perhaps in the absence of collective details as to the whole welding industry in Britain a glance at the output of the livest business organization of the kind in the United Kingdom will best show how splendidly this industry is meeting the insistent demands of the British war machine.'

"I had a chat yesterday with C. W. Brett, the managing director and general manager of Barimar, Ltd., of 10 Poland Street, Oxford Street, London, a firm of scientific welding engineers, which is by common consent at the head of the whole industry in Britain. Though still a very young man in the early thirties, Mr. Brett in conjunction with his colleague, H. E. Lamplough, works director, has built up a tremendous welding business here in the heart of London. Hither have been pouring in by thousands, fractured machines from all parts of the British Isles, aye, and even from the battle fronts of France and Flanders.

Thousands of motor lorries and other petrol propelled vehicles engaged in the transportation of army supplies are being kept in commission by Barimar's special processes. Harassed medical men in civil practice straining every nerve to do their own work and the work of colleagues on the battle front urgently appeal to Barimar to help them out of their transport troubles. In most cases autocar manufacturers have ceased to make private cars and spare parts, and if they had not you could not buy a new car without a government permit.

"All these factories are engaged on work of national importance, and, thanks to the wonderful energy and the active co-operation of all the men in the machine shops the British men on all fronts are magnificently supplied with engines of war, shells, bombs and munitions far in excess of anything that the wily German has been able to assemble.

"Here is a typical handful from a sheaf of letters and telegrams that daily reach Barimar. An important staff officer from the western front is temporarily stalled at a well-known southern sea port whence military men by the thousand weekly pass and repass to the seat of war. His car is badly holed. Can he have it in three days? He *must* have it for immediate use in Flanders. A shipbuilding firm in the north, of world-wide fame, has got among its patients a British submarine. A vital part of the engines must go through the mufflers and the flame and emerge free from distortion. Can Barimar do this? An urgent wire also from the north comes from a place which bears the same name as America's capitol, the seat of government. There machinery worth tens of thousands of dollars is held up, useless, by a bad break. Can *this* be got going by Barimar experts? Away in the west a British firm making some of the best known oil engines in the world is in like trouble. In the midlands probably the largest firm of cash chemists in the universe, whose name is a household word in Britain, is temporarily held up. Another task for Barimar. Here from three well-known British air craft centers are different demands, all of equal urgency, calling for the instant attention of scientific welders. Nothing else will do.

"And so on and so on. To me it seemed varvelous that a profession whose history dated back no further than ten or twenty years should have so soon become practically indispensable to the well being of the engineering world.

"That this is so is largely due to private enterprise. In Britain, Barimar, Ltd., have probably got the most comprehensive system of scientific welding that there is to be found in Europe. Here no fewer than six different processes of welding are in operation, including: Barimar metallurgical process; oxy-hydrogen welding; Oxy-acetylene welding; electric welding and brazing.

"Barimar largely owes its efficiency to the fact that its principals and many of its working experts have been engaged in this highly technical business something like ten years without a break. So pre-eminent has it become in its own line of business that the chiefs recently received a request from the officer in control of a well-known official training college at Woolwich to permit the army men to proceed to Barimar works for instructional purposes. Of a receptive frame of mind Mr. Brett is ever alert to improve and add to the effectiveness of the system, and at the present moment three additional processes, two of them entirely new, are being investigated and tested with a view to introduction.

"Chrome nickel and chrome vanadium have been successfully welded by Barimar. Nickel steel is used for welding crank shafts, axle shafts, teeth on crown, gear and bevel wheels. Nickel, vanadium, chromium, tungsten and cobolt are the principal metals alloyed with steel. Either can be used in conjunction with others in various proportions in the repair of crank shafts, gears, bevels, etc. A broken shaft of 40-ton tensile steel has been welded and the part has stood a strain of 50-ton tensile without injury or weakness to the part next to the weld. Complete success can practically be guaranteed in repairing crank shafts, gear wheels and steel parts if the exact percentage of alloys in parts under repair is known so that the same percentage and alloys may be used in process of welding.

"A good idea of the operations of this—the premier British firm may be gathered from the results of the last year or two's activities. The firm's filing system is probably far and away the most scientific and elaborate of the kind anywhere in use in firms of this description. I asked Mr. Brett to give me something in the way of figures to show the output of newly created of rehabilitated parts and in a few moments I received the result of calculations which gave a total of 17,000. What this means to Britain just now may best be gathered from the figures that go to make up the total. These show that Barimar had then reconstituted for the nation:

Aeroplanes	1,700
Transport vehicles	5,100
Admiralty parts	1,700
Commercial cars and lorries	4,250
Motors on government work, ambulances, etc.	4,250

"Just now the firm are devoting special attention to the question of air craft. Britain is at the moment out to do for the aerial arms exactly what Mr. Lloyd George, as minister of munitions, did for the artillery two years ago. If is now largely recognized that an overwhelming aerial force will do more than anything else to bring this colossal war to a conclusion, and Barimar intends to do everything in its power to help to maintain the efficiency of the nation's air craft."

HEAT PRODUCTION *in the* ELECTRIC ARC

By Otis Allen Kenyon*

IN FUSION welding the electric metallic arc is simply a heating agent, and its total heat production is equal to the watt consumption; that is, the volts across the arc multiplied by the amperes through it. However, contrary to what we might first think, the temperature of the metal bears no definite relation to the total heat in the arc, but varies widely with the distribution of that heat.

First of all the temperature of the metal depends upon the rate at which the metal melts, because for a given total heat, the greater the quantity of the metal passing through the arc the lower will be the temperature.

The rate of melting depends upon the heat production in the metal at and near the working end of the pencil, and this in turn depends upon the current, because as the current increases the resistance decreases, leaving the voltage consumed at that point practically constant, so that the heat production varies approximately in direct proportion with the current in amperes.

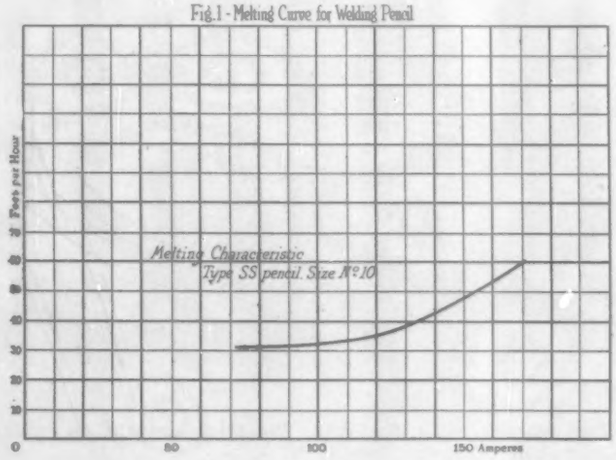

Fig. 1

In Fig. 1 we show the result of tests that bear out in a general way the above statement. This curve is called a melting curve and indicates the feet of pencil melted per hour with different values of current for a definite size of pencil.

As the metal must melt before it leaves the pencil, it is above its critical temperature, and unless it is cooled quickly, it will become coarse grained, but before it can be deposited in the weld and fused with the work, it must pass through the arc proper and be subjected to its high temperature.

The longer the arc stream the higher the voltage, and this voltage is not appreciably affected by the current through the arc, but only by the length of the arc. Therefore, the shorter the arc, the less the metal is overheated, and the quicker it will return below the critical temperature. Indeed it can return so quickly, that its grain size will be entirely satisfactory, while on the other hand, with an arc length only slightly greater, the metal will be so overheated, as to be practically ruined. The effects of voltage and the choice of voltage for different kinds of work, we leave to a later article. In the present instance, we are limiting ourselves to the effect of current.

To simplify the focussing of these ideas, we assume that the current determines the rate of flow of metal from the pencil. Also together with the heat brought in by the arriving metal, current determines the temperature at the point where fusion takes place in the weld, and in this latter case it helps to determine the depth of penetration of the melting or fusing.

Some claim that the current has a decided effect on the strength of the weld, and that there is a critical current at which a strong weld is made, and that only a slight deviation above or below this value will cause a marked falling off in strength. We have not found this to be true in practice, and therefore tests were made to study this phenomena.

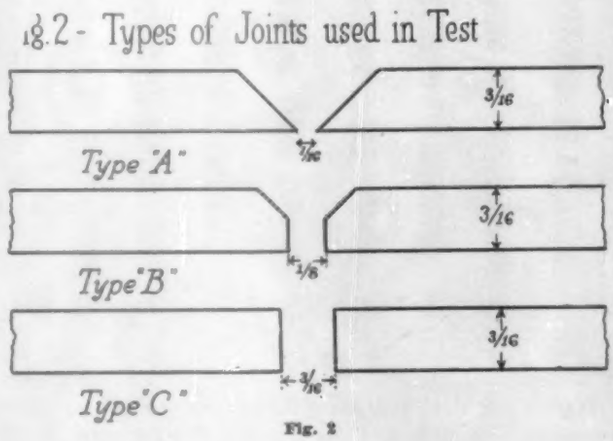

Fig. 2

In order to determine, if possible, the correctness of our theory regarding the effect of current above melting rate and depth of penetration, tests were made on three types of joints, shown in Fig. 2.

(a) Full Bevel
(b) Half Bevel
(c) Square

and used six values of current in each case, namely: (1) 80, (2) 90, (3) 100, (4) 110, (5) 120, (6) 130-amp.

The results of these tests are given in table I. The test numbers correspond to the numbers at the bottom of the test pieces in Fig. 3, which shows the broken specimens. The tests of the pieces after the welding was completed, were made by the Pittsburgh Testing Laboratories.

All specimens shown in table 1 were welded as near

*Arc. Welding Machine Co., New York.

flush as possible, and machined to the same thickness as the original plate.

It will be noted:

1—That the current did not affect the strength.

2—That with the full bevel joint where the arc came into direct contact with the entire surface to be fused, that all welds were stronger than the material itself.

3—That in the half bevel and square joints where penetration is necessary in order to fuse the entire section of the joint, that the pieces welded at low currents broke in the weld, while those at high currents broken outside.

4—That excellent welds can be made over a wide range of current variation, providing there is current enough to produce the proper depth of fusion in the joint, providing always the voltage never exceeds a comparatively low value. (In these tests there was between 18 and 22 volts.)

5—That the value of the current does not affect the quality of the metal, but simply the quality of the weld, as determined by penetration of fushion.

Although the value of the current does not affect directly the quality of the weld, it does affect the speed, both as to melting, speed, and ease of working.

For each size of pencil there is definite range of current within which it is practical to work. If the current is too low, difficulty is experienced in securing the proper penetration of fusion, and also maintaining the arc. If the current is too high, the pencil melts too rapidly for proper manipulation, and also making the operation of welding unnecessarily difficult.

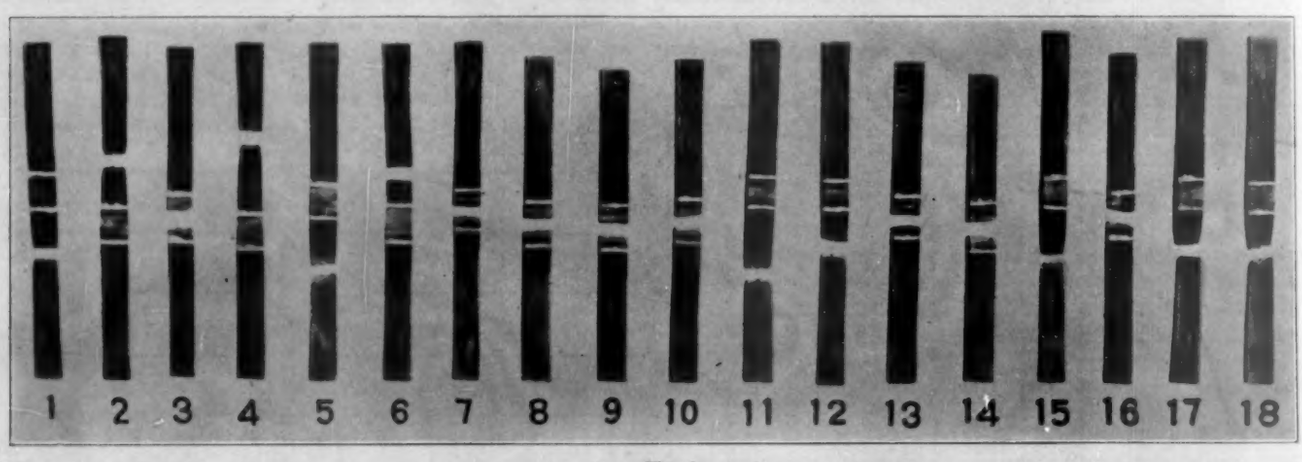

Fig. 3.

TABLE 1—RESULTS OF PULLED TESTS ON WELDED SPECIMENS.

No. Test.	Type.	Amperes.	Strength. Yield.	Break.	Location.
1	A	80	31,540	51,040	Mat.
2	A	90	45,400	59,440	Mat.
3	A	100	41,790	54,680	Mat.
4	A	110	45,500	59,770	Mat.
5	A	120	34,790	56,310	Mat.
6	A	130	42,490	56,190	Mat.
7	B	80	37,700	57,590	Weld
8	B	90	32,290	51,440	Weld
9	B	100	29,000	40,790	Weld
10	B	110	43,910	43,830	Weld
11	B	120	30,540	49,650	Mat.
12	B	130	32,430	51,980	Mat.
13	C	80	31,170	49,840	Weld
14	C	90	39,580	40,690	Weld
15	C	100	43,130	57,270	Mat.
16	C	110	31,960	52,800	Weld
17	C	120	41,780	57,120	Mat.
18	C	130	39,160	57,780	Mat.
37	A	Gas	28,360	38,390	Weld
38	B	Gas	.....	38,260	Weld
39	C	Gas	34,200	50,310	Weld

SERVICE OVERSEAS.

Welders are wanted for early service overseas. The men in the front line trench need the help and co-operation of skilled men back of the lines, and welders are wanted at once for the Enlisted Ordnance Corps, National Army.

Uncle Sam is calling on our trade to come across and help his fighting men. There is a lot of work to be done over there, and the call has gone out for welders between the ages of 18 and 40, who want to do their bit, and who know their job.

Modern war is a tremendous business, and the army that wins, is the army which has the best equipment and the best men. The men are over there now—they are ready to go ahead, but they still need experts in our line to repair and maintain their equipment. There is a fine chance for every man who wants to help.

Write to the Chief of Ordnance, War Department, Washington, D. C.

D-B OPEN NEW OFFICES.

New sales offices have been opened by the company during the past year, and with general offices at Jersey City, additional sales offices are now located in the following cities: New York, Boston, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Chicago, Detroit, St. Louis, Seattle, San Francisco, Los Angeles, with the Carter Welding Company as general dealers in Toronto, Ontario.

The Davis-Bournonville Co., Jersey City, has recently opened a government sales office in the Colorado Building, Washington, D. C., with Henry R. Swartley, Jr., resident manager. The company manufactures oxy-acetylene welding and cutting apparatus and oxygen and hydrogen producing apparatus, which is being used extensively by both army and navy.

DOLLARS IN THE SCRAP PILE.

Saving hundreds and even thousand of dollars every year through an analysis of the scrap-pile is not a theory, but an actual demonstration one may meet with in many of the larger machinery plants, factories and mines of the country.

Now that the country is at war and all the departments of the government are calling for conservation of this, that and the other thing, plant owners are thinking twice and scratching their heads, before discarding a broken machine or a partly worn apparatus or tools of any kind. Through the various modern processes of welding—and especially through electrical and oxy-acetylene welding—machines, tools and materials are reclaimed and put back to work earning profits, rather than being sold to the junk man for old iron.

OXY-ACETYLENE STEEL CUTTING

By William Herron,

New York Navy Yard

The cutting of steel plates, channels, angles, eyebeams, etc., by the oxy-acetylene process has become one of the most important operations in the fabrication of steel structures in the ship building industry, steel mills, locomotive plants, boiler shops, etc., within the past four years, and in consideration of its rapid strides it is reasonable to foresee greater use and application for it.

In proportion to the important place which it has so meritoriously won in these industries the process has received but little study by those who regard it as indispensable, and while the results of its use have been found

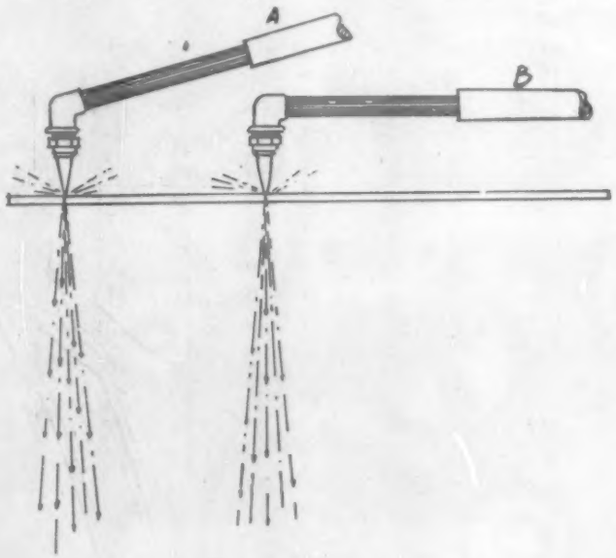

Fig. 1

so satisfactory by them it is well to say that it is now doing but a small percentage of the work for which it is capable of accomplishing.

There are many factors which are overlooked in the execution of the work, due primarily, to the unfamiliarity with the process by which those with whom it has been put in trust.

The advantages of cutting steel by this process over that of any other method is unquestionably in its favor. Steel of any thickness can be cut into any shape with speed varying from four to twenty inches or more per minute at a decided saving in both time and labor over all other methods. It is true that the cutting torch is on a par in usefulness with the pneumatic hammer and its use would be as indispensable as the latter in every case.

Since the advent of the oxy-acetylene welding process several years ago the use of the same two gases for cutting steel eventually followed, and has made as rapid progress in the manufacturing world as the welding process itself. It has taken these past four years to bring to its present state of efficiency the welding and cutting equipment so essential to the proper manipulation of the oxy-acetylene flame, so that now it is not a question of better instruments but to what new line of manufacturing the process can be made to serve for both welding and cutting.

Cutting Action of Oxygen

The burning or cutting of steel being a chemical action (and not a mechanical or melting one as it is so often supposed) it is absolutely necessary to understand fully its theory. The theory made clear covering this action, being, that oxide of steel burns, and is consumed at a lower temperature than is the metal itself, therefore, in an atmosphere of oxygen molten steel will oxidize, the oxide will burn, creating intense heat, keeping the metal always at the melting point and as rapidly as new oxide is formed it is burned, until the steel is completely consumed. Therefore, a properly designed instrument using a highly concentrated heat as the combustion of oxygen and acetylene produces, together with the means of exposing the heated area to a

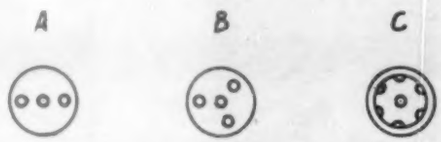

Fig. 2

stream of oxygen will result in the proper guidance of the burn. On this principle lies the introduction of the oxy-acetylene cutting process.

Design of Torches

In the cutting torch we have two distinct features, namely, the heating jets and the cutting jet. In starting a line of cut the heating flames bring the metal to a red heat to start combustion, the cutting stream of oxygen, which, on the opening of a finger valve is impinged on the heated spot starts its burning action immediately. When the oxide has started burning it creates the greater part of the heat necessary for combustion from the high temperature generated, the pressure of the oxygen forcing the burnt oxide through the metal in a perpendicular line. Theoretically there is enough heat in this combustion to carry on the cutting, but, due to the unsteadiness of the hand and the necessity for heating the steel to start the cutting action an auxillary heat is required to maintain the heat in advance of the cutting oxygen. This action continues along a line of cut and renders the cutting of steel a very practical process.

The numerous makes of cutting torches at present on the market vary but slightly in general principles, the manufacturers developing their product more or less, along a standard design, this being especially noted in the almost universal adaptation of a 90 degree head, where formerly at least one-half of the torches manufactured were of the 100 or 110 degree type. (Fig. 1.) There still remains however a difference in the style of tip used. This difference can be arranged into three classes (Figs. 2, A, B and C.) The two flame, the concentric three flame and the concentric

six flame types. For free hand cutting all three types are equally as effective that is, they consume when properly adjusted approximately the same quantity of gases for a given thickness, manufacturers emphasizing the use of the proper pressure of both oxygen and acetylene for which their torches have been designed. For machine cutting of irregular shapes the six or multi-flame type is used exclusively. There is also a variance in the method of opening the valve for controlling the cutting oxygen, some torches having a trigger movement similar to that of a rifle, others a button on the torch handle which is pressed by the thumb, and still another type having a knobbed pin which is snapped down on the side of the handle. All three styles of valves being held open or closed automatically. There are also a few special kinds of hand cutting torches, the one most extensively used being the circular cutting torch which is so constructed as to be held vertically and revolved on a trammel which can be adjusted to cut a circle of any diameter up to twenty-four inches. Where circles are cut this style of torch proves to be a decided advantage in producing a perfect circle with parallel walls.

There has been offered in a torch recently introduced on the market a new design of valve control for regulating the pressure of the cutting oxygen. The arrangement being that of a lever which runs parallel with the torch handle, when the oxygen is to be applied the operator tightens his grasp on the handle, and likewise the lever, allowing it to slip the desired number of notches where it is held automatically in place. There are five notches, each one representing an increase of pressure. Where plates of varying thickness are cut it aids in conserving the consumption of oxygen by having the regulation of the pressure at the operator's immediate control, instead of requiring the adjustment of the regulators at the cylinder for every change in plate thickness which takes up considerable time.

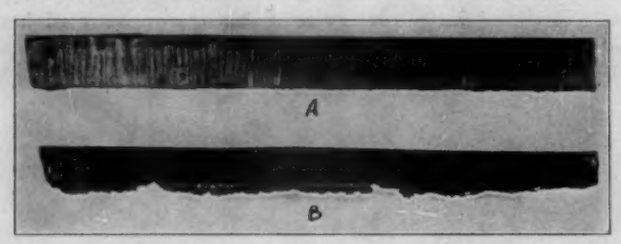

Fig. 3

Classification of Operators

Operators of cutting torches are classed throughout the steel industries as BURNERS, the title benefitting them in every respect, for we find as a general rule nothing more than a burn in the work which they perform. So much attention has been given to welding, so closely related inasmuch as the principle of combustion is concerned, that it has induced skilful workmen to study the art, but with the cutting process it has been unfortunately the reverse. There are, no doubt, less than ten percent of the operators of cutting torches at the present time who understand the action of their flame; the limit of their skill being in guiding the torch along a chalk line and burning the steel, thereby severing the pieces. They cherish the idea that the force of the oxygen against the steel alone carries out the cutting.

One of the principle reasons for these conditions being that superintendents and foremen know as little about the cutting process as do the operators themselves, and cannot therefore, detect good work from bad. This results in having the art remain always on the same plane. Another reason, also due to lack of knowledge of the prerequisites of an operator, is, that the BURNER is extracted from amongst the helpers of different classes of mechanics, and is, more or less, without skill in the use of any tool, let alone a cutting torch. The desire to handle a torch is enticing to the average helper and he applies to his foreman for the next opportunity to lean the operation of a torch. The foreman who considers it only as an untrained mechanic's job, and the superintendent anxious to keep the wage scale as low as possible, deem it a good more to "let the young fellow have a chance." After a week or more of breaking in with a fellow BURNER he is given an outfit of his own and is proclaimed eligible to BURN. He daily learns to cut faster, and in his own opinion better, but he never known why his torch cuts, for few of his class understand the seemingly mysterious action of the cutting flames. While it is not necessary that these men should be drawn from the welding ranks, it is necessary that apprentices should be instructed in the use of the torch by skilled operators.

Pure and Impure Oxygen

The most essential factor in the accomplishment of a good cut is the use of pure oxygen. This fact cannot be dealt with too much. Oxygen produced by electrolysis of water being generally the purest, while that derived from the atmosphere being many times decidedly inferior. It has been ascertained that oxygen containing as little as 8 per cent of foreign gases is unfit for cutting, while the cleaner the cut will be and the more economically it will be made as the percentage of foreign gases decreases.

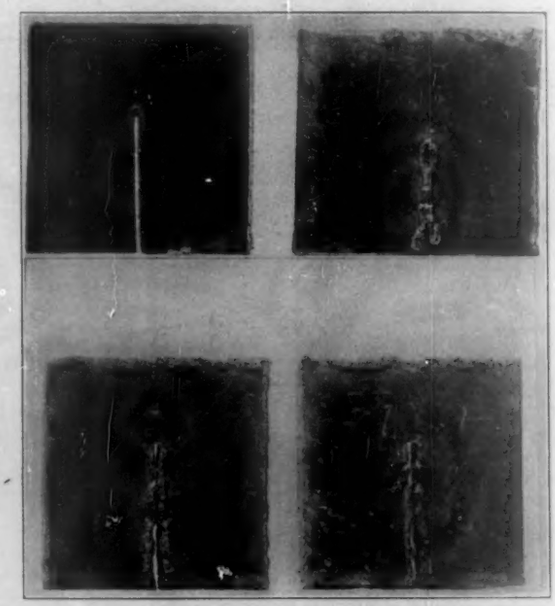

Fig. 4. Views A, B, C and D

In Fig. 3 is shown a cut of one-half-inch steel made with pure oxygen (99 per cent pure) and that of a cut made with impure oxygen (97 per cent pure). The cut A being accomplished by a pressure of 20 pounds and at the rate of 11 inches per minute using an acetylene pressure of one and a half pounds. B shows the cut made with impure oxygen on the same thickness at a pressure of 50 pounds with the same pressure of acetylene and at the rate of 9 inches per minute. It will be seen from this that it requires 150 per cent more oxygen of impure quality to accomplish the same results as that obtained by the use of the better grade, not to mention the increased width of the cut, the added time required to cut the same length and the depositing of unburnt oxide along the line of cut.

The majority of superintendents and foremen in plants where the process is being used extensively have not had it made clear to them either by demonstration or by explanation the value of the use of pure oxygen. To their knowledge, oxygen has always been oxygen. Any oxygen will cut. Pure oxygen can be purchased as readily as impure oxygen and the value of it over the poorer quality gas

should discontinue its use entirely. Discrimination in the purchasing of oxygen will eventually reduce the cost of cutting almost 60 per cent of its cost today. From this is meant the savings in the quantity of oxygen used, the expense of chipping slag from the line of cut, reduced speed in cutting, handling and express charges of extra cylinders, and numerous other drawbacks which follow the use of the cheaper quality oxygen.

Why Pure Oxygen Excels

Pure oxygen oxidizes more of the heated metal and much faster than does impure oxygen. More oxide is therefore completely consumed, which leaves the cutting line free for the rapid advance of the cutting stream resulting in a very neat and accurate cut. Impure oxygen does not oxidize as much of the metal and not as fast as pure oxygen, consequently, the oxide is not completely consumed. This unburnt oxide impedes the advancement of the cutting stream by clinging to the bottom of the cut, preventing the oxygen from forcing its way through it.

We have shown in Fig. 4 the bottom of the line of cut of steel cut with pure oxygen and that of steel cut with impure oxygen. It will be noticed that the cut A made with 20 pounds pressure of pure oxygen is clean and free from slag, while the cuts B, C and D made with 20, 30 and 40 pounds pressure of impure oxygen hold much slag, the amount decreasing as the pressure is increased.

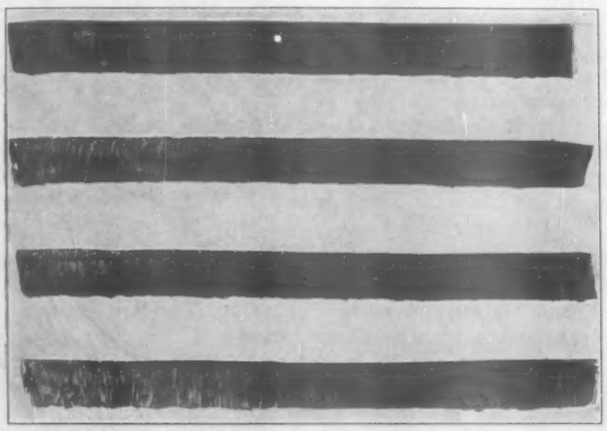

Fig. 5. Views A, B, C and D

Steel Cutters—Not Burners

The term CUT should be substituted for that of BURN, for while burn is predominantly used wherever the process is applied its aim is to cut as if by a mechanical means, instead of to burn as by the melting method.

BURNERS should be educated into STEEL CUTTERS. Proper instruction of this class by an operator understanding the action of the flame would immediately improve the quality of this class of work in those plants where it plays such an important part.

The use of pure oxygen with proper understanding of the pressures required in using the various torches is the preliminary step necessary to acquire this change. Practical explanation and demonstration being the course to pursue in bringing before the eyes of the operators the more subtler reasoning in the execution of their work. An operator once shown seldom forgets and in spite of being previously ignorant of the facts which are now pointed out to him he will become a skilled operator; his cuts will be clean, straight and square, and instead of hammering out or bending off pieces as heretofore, they will drop off automatically, due principally to the use of pure oxygen. As in many other arts which require skill in turning out accurate work it is the natural tendency of a steel cutter after he is once shown superior work, to compete with his fellow worker in attaining an ideal cut of steel.

A first-class steel cutter should cut with the consumption of a minimum amount of oxygen and acetylene, ascertaining the proper pressure for a given thickness of plate by the working pressure indicated on the gauges. To explain this more fully. In Fig. 5 we have it shown that we accomplish the same results by the use of 20 pounds pressure of oxygen that we do by using either 30, 40 or 50 pounds pressure. A cut cannot be made faster or better by increasing the pressure, but on the other hand it is made considerably worse, inasmuch as it makes a thicker cut and the edges are not as keen. With poorer quality oxygen it is different, in, that by increasing the pressure a slightly cleaner cut is made, due to the fact that the heated area is exposed to a greater quantity of oxygen which attacks the oxide at a greater velocity, the increased pressure forcing the slag away from the cut. Fig. 6 shows cuts made with impure oxygen at 20, 30, 40 and 50 pounds pressure. A comparison with those cut with pure oxygen clearly shows the difference.

The prevailing idea that there is less skill needed for cutting than there is for welding is more or less unfounded. A good steel cutter must cultivate skill equal to that of the welder in welding, for both arts run hand in hand. He must have a steady hand for the proper guidance of the torch and be able to move it along a line with uniform speed. He must be able to adjust the pressure of his gases so that there will be sufficient heat to maintain the combustion action of the cutting oxygen. Too much heat will cause an undue melting of the metal which leaves a very blunt edge on the pieces cut, besides causing particles of slag to fly back into the mouth of the cutting and heating jets, causing flash backs of the heating flame and diverting the stream of cutting oxygen which cuts the metal in curious shapes. Too little heat will prolong the time necessary for cutting a given length with the consequent loss of oxygen. A study of the heating flame is necessary to determine the exact heat required for the different thicknesses of metal.

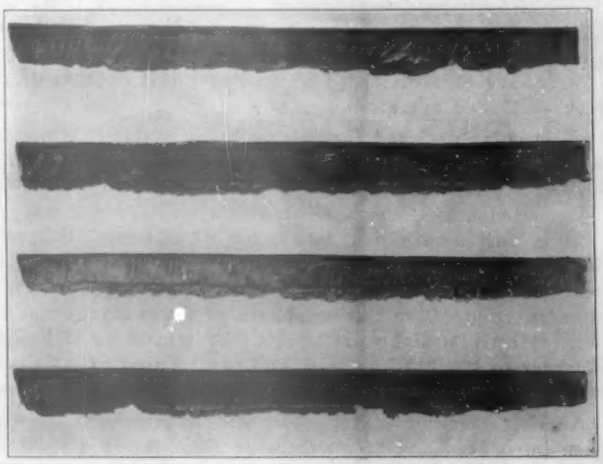

Fig. 6. Views A, B, C and D

Operators should study their gauges. Working pressures for the heating flames and the cutting stream should be adjusted at the regulators and not at the torch, as is so often the case. The average pressure of oxygen required by the different makes of torches is about 5 pounds pressure to every eighth inch of thickness. This applies to the use of pure oxygen; with impure oxygen the pressure will increase accordingly. Gauges are very delicate instruments and will not stand very much abuse. With proper care, however, they will read accurately for many years.

The tips of the cutting torch should be kept clean by frequent use of a smooth wire for loosening particles which adhere to the orifices and fly into the bore for a short distance. When the jets become coated it offers resistance to the gases, especially the cutting oxygen whose path is

swerved, resulting in a spread at the jet.

Hose lines should be tested regularly, especially the oxygen line, not only does a leak cause a waste of gas but the pressure at the torch cannot be kept uniform. A leaky hose always invites trouble and many fatal accidents have been caused by negligence in this regard. An operator is judged by the condition of his apparatus, and, as a general rule, his work corresponds thereto.

Until there is introduced amongst the operators in this field enthusiasm for more skilful work, we cannot look forward for any appreciable advancement in the art. Manufacturers of equipment have reached a point in the development of their apparatus which meets every requirement of the vast number of users at the present day. When the human element of practice reaches the point where it will welcome more precise instruments there will be in readiness very possible improvement necessary for increased efficiency of operation.

Cutting Machines

There are on the market at the present time a few types of cutting machines which, when properly controlled, produce most excellent work. We find however that much unfavorable criticism has been accorded many of these machines, due entirely to the misunderstanding of their action by operators and superiors. In a few plants cutting machines have been discarded or used sparingly because of the lack of skilled operators.

A machine designed for cutting heavy plates has found a wide field of usefulness. The unit is very compact, comprising a small motor mounted on wheels which are guided by grooved tracks, and a torch with a specially designed tip. The cutting accomplished by the use of this machine cannot be duplicated by any other process. The torch being guided along the line of cut at a uniform rate of speed and without any deflection of the cutting stream produces a very smooth cut, perfectly straight and square. This machine is limited however to straight line work and can be used to cut thicknesses of one inch and up.

Another machine on the pantograph principle has also been introduced and in plants where duplicate pieces of irregular shapes are required it has been found to be indispensable. The torch or torches on this machine are also moved at a uniform speed by a small electric motor. A pattern of the shape to be cut is followed along its lines by a guide which in turn moves the arms of the machine which holds the torches. This machine produces a very accurate cut regardless of the shape of the pattern and the work turned out cannot be duplicated by any other process. In machine cutting the use of pure oxygen also plays a most important part in giving both a smoother and faster cut and eliminating all chances of interruption by the accumulation of slag at the bottom of the line of cut met with by the use of impure oxygen.

Methods of Improvement

Aside from the advantages to be obtained from the use of better oxygen a word may be said regarding equipment. In a great many shops too little attention has been paid to the requirements of the worker, which has resulted in checking the innate desire of the average operator to produce a better grade of work. Steel carts which hold in a very compact manner a complete cutting unit assists in making the work of the operator easier and greatly increases the flexibility of the operation. Besides having a torch for straight and free hand cutting, each operator should be supplied with a circular cutting torch. Circles, especially when less than six inches in diameter, when cut free handed are much out of line and require a great deal of trimming to be made uniform. The circular cutting torch can be attached in a few minutes, and it is well worth this little while to make the change even for the cutting of only one or two circles. Circles cut with this type torch are cut much faster, and with a less expenditure of energy.

Many operators never see the sense in wearing glasses, and it is pointed out that these are most generally the poorest class of operators. The brilliant light thrown off by the buring of the steel is very harmful to the eyes and a shaded glass should be used. A black glass not very dark, so that center punch marks and the chalk line can be seen, has been found to protect the eyes very satisfactorily. Aside from protecting the eyes from the strong light they also help in keeping sparks and flakes thrown off by the heat from flying up into the eyes.

In those industries where a score or more of operators are employed, they should be controlled by a chief operator who understands fully the oxy-acetylene process of cutting; preferably a man who is a first-class artisan and possessing knowledge of the apparatus used. Such a man would oversee the work done by individual operators, and could instruct those who lack skill in using the torch and adjusting their gauges, thereby increasing the efficiency of this group of workers. Expenses of cutting could be reduced enormously by having those operators who use an excessive amount of oxygen and acetylene reduce their working pressure to the minimum required to cut steel of the various thicknesses.

A foreman in charge of steel cutters alone would accomplish much more than by having the regular shop foreman oversee this class of work. His efforts could be confined to providing all the needs of the operators, such as the handling of the full and discharged cylinders, apportioning the work, instructing, etc. In general, assuming responsibility for the cutting in a systematic and economical manner. Expenses of cutting will never be reduced unless such steps are taken for development along these lines. Records should be kept of all work on forms devised for this purpose, the facts ascertained would aid in setting laws to govern the work and workers.

There is an advantage in using standard equipment throughout a plant. Where torches of the same type are used operators can be judged as to their individual ability more accurately, for it cannot be the fault of torch design which would prevent one operator from producing work equal to that of another. Another advantage being that fittings are interchangeable and a supply of parts can be kept in stock for repairs at any time, wrenches fitting one outfit will fit all, and many other benefits resulting therefrom.

Other Steels and Gases

While it is not desirable to delve into the cutting of various grades of steels and heavy plates, it may be said that in regard to thickness the principle is precisely the same, while the cutting of all steels excepting those containing a high percentage of carbon is also the same. In high carbon steel the melting point of the metal is much lower, which causes the oxide to fuse at almost the same degree of heat as the metal itself. High carbon steel is cut, however, but with less speed than mild steel and the cut is not as smooth. Mild steel as is known melts at 2860 degrees Fah., while high carbon steel melts as low as 2500 degrees.

In mild steel, cutting by the process has absolutely no effect on the structure of the metal along the line of cut. Analysis has shown that the quality of the metal in this area is not affected in the least by the action of the cutting flame. The same can be said of carbon steel. In many instances dies have been cut from this steel whose cutting surface was machined but a few thousands, the metal being unharmed in any degree.

In a few special steels such as that used for armor plate it is impossible to machine the edge which has been cut by the process, due to the air chill which it receives. The special heat treatment of this steel undergone in its manu-

(Continued on Page 34)

WELDING CAST IRON WITH THE ELECTRIC ARC.

By Robert E. Kinkead.*

The rapid development of the Electric Arc Welding process has brought forth the question of its adaptability to the welding of grey iron. Like many other new processes, the Electric Arc Welding process has suffered a good deal from over enthusiastic partisans who have had more or less inaccurate information. Welding with the heat of an Electric Arc is, indeed, a wonderful process, and the things which have been accomplished with it are sufficient cause for all of the enthusiasm which has been aroused. Yet it is worth while to keep pretty close to Nature in fundamental facts in applying the process, particularly to the welding of grey iron.

Grey iron can readily be welded by any of the autogenous welding processes. It cannot be welded in a forge fire. The principal of the autogenous weld is that the metals to be welded are heated to a molten state and made to consolidate into a homogenous mass. Autogenous welding differs from the older forge welding process in that no mechanical pressure is required to make the weld, due to the high temperature of the metals. It is evident, therefore, that any two pieces of the same metal may be welded together by an autogenous welding process. It does not follow, however, that any two pieces of the same metal may be welded by any of the autogenous welding processes; for instance, brass cannot be welded by the Electric Arc process, owing to the fact that the temperature of the Electric Arc is too high to apply to brass. Different metals which have an affinity for each other at high temperatures or which alloy may also be autogenously welded.

The autogenous welding processes in the chronological order of their application are the Thermite Welding Process, the Oxy-acetylene Welding Process and the Electric Arc Welding Process.

The old way of welding grey iron in the foundry was to embed the casting in the sand and pour hot metal over the fracture until it became hot enough at that point to unite with the iron which was being poured over the fracture. In principle, this was autogenous welding. In the newer processes, instead of heating the fracture to a molten state by pouring hot iron on it, the oxy-acetylene flame or electric arc furnishes the intense local heat for this purpose. The grey iron to be added is in the form of a rod and is called a "melt bar." It is usually of a high silicon content so that it flows readily. The two difficulties encountered in the welding of cast iron arise from expansion and contraction of the local area heated by the gas flame or the Arc, and the tendency of the weld to become hard when the casting has cooled. Grey iron is difficult to weld successfully by any of the autogenous welding processes because of these two facts. With the proper equipment of preheating furnaces, skilled operators, etc., it is possible to sucessfully weld 95 per cent of the broken grey iron castings that are worth repairing, using the oxy-acetylene process. Probably 80 per cent of the broken castings can be welded with the carbon electrode electric arc welding process. A well equipped shop has both the oxy-acetylene and electric arc apparatus and uses the arc where possible, due to its very low cost of operation.

Recent attempts have been made to weld grey iron by the Metal Electrode Arc Welding Process, using a steel electrode. In this method the arc is drawn between a steel rod and the casting. The heat of the arc melts the rod and a small area of the casting. Molten steel from the rod merely drops on the casting. The possibilities of this plan seem somewhat limited, however, due to the fact that the steel deposited on grey iron when both metals are molten, absorbs a high percentage of carbon, and becomes very brittle. This process when applied without preheating the casting results in a very unreliable "weld." The localization of the heat in the metal electrode arc process is so great that the metal goes through the heat cycle; i. e., is brought to the molten state and cooled in a very few seconds. Probably in ordinary operations of this kind a unit volume of grey iron at the fusion line passes through this heat cycle in a matter of five seconds. The effect on the grey iron which has suffered this treatment is practically the same as if the iron were heated to a molten state and quenched in water. The effect on the steel which has been deposited on the grey iron and is near the saturation point in carbon is the same. The net result of this practice is to give metal at the time of fusion which is as hard and brittle as glass, because on the cast iron side of the line of fusion we have chilled iron, and on the steel side, quenched high carbon steel.

There are a number of castings on which such a weld is good enough, but on any casting the failure of which carries with it the possibility of death and destruction, to use such a weld is to court disaster.

The very properties of the Metal Electrode Arc Welding Process which makes it serviceable in steel welding, namely, great localization of heat, make it difficult to weld on grey iron. Some very excellent work has been done using the Metal Electrode Process, using a cast iron Metal Electrode instead of a Steel Electrode, and preheating the casting carefully before welding. In this process it is desirable to have the cast iron electrode on the positive side of the welding line. In some applications the flow of the metal is controlled better using the cast iron electrode rather than the cast iron melting bar with a carbon arc.

Welding cast iron with the electric arc process is a practice which will be very common within a few years. Any good oxy-acetylene operator with two years' experience in general repair work can handle the arc process and accomplish, with a few exceptions, the same things which may be accomplished using the oxy-acetylene process. The exceptions are jobs where grey iron of a section less than one-fourth inch in thickness is to be welded. The application to the welding of the cast iron has already been shown to be possible and to be considerably cheaper in operation than the gas process. Whenever it becomes possible to perform a certain operation at a lower net cost by a new method, that method becomes an economic necessity.

The rather high initial cost of the electric arc welding equipment has been the principal cause of its slow progress in this field. The highly skilled operator of the gas process, who several years ago went into business for himself with a small amount of capital, now appears as the head of a prosperous commercial welding company; and while in the past he may have stood loyally by the gas process, because this was his "first love," it seems highly probably that the fact that he can make more money by welding the same jobs with the electric arc process will make it very attractive to him.

The commercial operator requires approximately 200 amperes welding capacity, and the market price of this equipment is approximately $1,500.00 for motor drive, or $1,800.00 for gasoline engine drive.

*Engineer Welding Dept., The Lincoln Electric Co.

NEW "SUPERIOR" GENERATOR.

The Superior Oxy-Acetylene Machine Co., Hamilton, Ohio, are placing a new line of acetylene generators on the market. A complete description of the new generator will appear in a later issue.

HAUCK BOOK FOR COPPERSMITHS.

The Hauck Mfg. Co., Brooklyn, N. Y., have issued Bulletin No. 92-W, relating to apparatus for the coppersmith and for pipe shops. It contains a mass of useful information for the welder.

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Copies mailed as samples to prospective subscribers	762
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VOLUME 2. DECEMBER, 1917 NUMBER 12

Labor Peril in War.

THE LABOR problem in its various phases is pressing for solution. The men charged with winning the war for the United States are discovering that they will fail unless the muscle of the country is enlisted on a more satisfactory basis.

Generally speaking, there is no difficulty so far as the industries are concerned. The factory workers are well paid. The great expansion of war industry during the years the United States was a neutral has enabled the manufacturers to meet the enormous demands of the Government without serious delay.

In other activities where labor is an important element there is a less satisfactory situation. This is true particularly of the shipbuilding and coal mining industries.

Both of these industries are the foundation of American success in war. Without their full development by plenty of labor, other war activities must lag behind or cease altogether.

It is in the shipbuilding industry that labor conditions seem to be most unsatisfactory. Several important warships have been held up recently by strikes.

As soon as the Federal conciliators adjust a grievance at one yard, a quarrel breaks out in another. As in the coal mining industry, the granting of higher wages does not solve the difficulty.

If more money would keep the men at work at top speed the Government would pay more, within the bounds of reason, rather than see the shipbuilding program fail.

Training Army Welders

BEHIND the lines in France welders will play an important part. It is said that every machine, every locomotive, every automobile, and every repair part for the use of our army must come from this country. A broken part means idleness, until a new part is supplied or repairs are made. As the shipment of duplicate parts of every sort means not only delay but valuable cargo space as well, it would seem important to provide the best talent in emergency repair men. A broken automobile truck can't bring up supplies or ammunition to our boys. By the same token a faulty weld might mean a stalled ammunition truck and the loss of thousands of lives. Also, two thousand feet in the air is no place for a poor piece of welding.

The Army should establish several schools of welding at once, as a sufficient number of good welders to meet both army, navy, and industrial needs are not available. At the various cantonments there are thousands of men, of mechanical experience, who are well qualified to become welders. Ninety days' to four months' training would make of these men the sort of welders we are going to need later.

Two Years' Work.

IT IS with a great deal of pleasure that *The Welding Engineer* directs the attention of the trade to the fact that with this issue this publication has completed its second year. We feel that we have a just reason for being proud of the progress *The Welding Engineer* has made, which by the way is entirely due to the helpful and co-operative spirit of the entire trade. We have made mistakes, of course, and we shall probably make our share of them in the future, but nevertheless we enter upon our third year's work with a great confidence in the future of welding, and with a determination to make *The Welding Engineer* even more helpful and instructive in 1918. To the good friends in every part of the North American Continent who have helped us in many ways we offer our thanks and we take this opportunity to express the hope that they may participate in the prosperity of the welding industry in 1918.

Are You a Real Welder?

LAST month we published an announcement under the above title. We offered to send out test pieces of steel to twenty welders who would make application for them. The idea is to have the weld made and returned to *The Welding Engineer* for inspection and criticism. More than 125 welders made application for test pieces. The first twenty pieces have been sent out and returned and the result of our inspection will be published in the January issue of *The Welding Engineer*. Twenty pieces will be sent to applicants in January, and twenty in February, pieces being sent in the order of the receipt of applications.

The Welders' Association.

IT IS to be hoped that the committee of the International Acetylene Association charged with the duty of drafting a plan by which all welders may be admitted to membership in the association will report in the near future. It is also to be hoped that the findings and recommendations of the committee will be acted upon promptly, to the end that the International Acetylene Association may become a real constructive force in the welding industry.

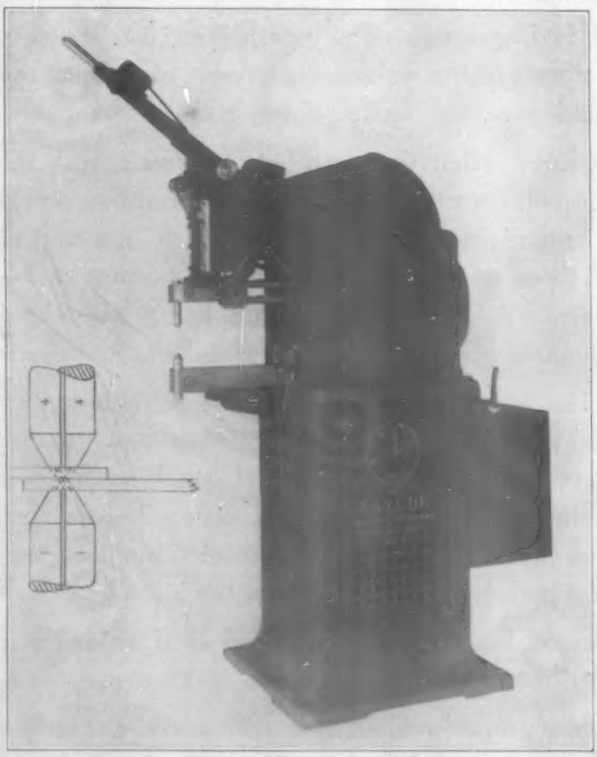
The welding industry needs the help and co-operation of a strong aggressive technical society and it is felt that such an organization could do much to advance and improve the art of welding.

NEW ELECTRIC SPOT WELDER.

A patent has recently been granted Mr. A. C. Taylor of The Taylor Welder Co. to manufacture and market a machine employing this new process. The fact that this machine will be placed on the market at outright sale will without a doubt be welcome news to many manufacturers who have use for equipment of this kind, but have held the actual installation in abeyance awaiting the final decision regarding the spot welder situation in particular; it being generally understood that additional litigation is contemplated, and it is thought that action will be started at a very early date.

Mr. Taylor, to whom this patent has been granted, has for a number of years been closely identified with the design and manufacture of electric welding apparatus and is one of the pioneers in the spot welding field. He has been connected with the Winfield Manufacturing Company for a numbr of years past and was one of the organizers of the Winfield Electric Welding Machine Co. when that concern first placed on the market the Winfield line of welders, including both spot and butt welding machines. Mr. Taylor has severed his connection with the latter company, but will be retained by the Winfield Manufacturing Company to serve in a consulting capacity.

The Taylor Welder Co. is being incorporated under the



laws of the State of Ohio and enters the field with excellent prospects for a very successful career. A temporary office will be opened at 12 Atlantic St., Warren, O., and it is not unlikely that the new company will contract with an established concern to build its product, owing to the fact that considerable delay would be experienced were an attempt made to build and equip a new plant at this time.

Directors of the new organization will be elected at a very early date and they undoubtedly will select Mr. Taylor as President, with Mr. A. E. Hackett and J. H. Ewalt, Secretary and Treasurer respectively. In addition to his duties as Secretary, Mr. Hackett will also have direct supervision of sales; his connections with the Winfield Electric Welding Machine Co., which covered a period of several years spent in the Engineering Department and for the past year in charge of sales, is sufficient assurance of his ability and also that the product of The Taylor Welder Co. will be vigorously pushed and a high degree of service maintained for the benefit of those using their apparatus.

The principle employed to produce a weld by this newly patented process is illustrated in the small sketch on the accompanying photograph, which represents the electrodes or welding dies as seen from the front of the machine. The lower horn and the upper point holder together with the welding electrodes themselves are split and a suitable insulating material placed between each piece. The secondary leads from the transformer are likewise separated and cross where the connection is made to the lower horn causing the current to be crossed over the path of each other on crossed and intersecting lines as illustrated by dotted lines in the sketch. A weld so produced has been demonstrated to be stronger and also made in a shorter space of time than has heretofore been possible with the old process. The use of the electric welder for welding material above ¼ inch in thickness has heretofore been a comparatively slow and doubtful operation, in that the electrode, being of copper, requires frequent dressing, due to the fact that the pressure which it is always necessary to apply to properly set the work together causes these parts to mushroom or flatten out and the time spent to redress them often offsets the saving which spot welding would have shown over the old riveting method.

By means of the new process it will be possible to separate the electrodes a sufficient distance to allow other means to be used in setting the work together, thereby relieving the electrode of that which has always been a detriment and only requiring them to conduct the current to the work. Thus a large field that has heretofore been beyond the range of ordinary welding conditions up to the present time can now be reached and developed.

Another feature which makes this process unique is that it can be arranged to operate on multiphase current so that the manufacturer generating his own power will not be obliged to connect his welder to two sides of a three phase circuit with the resulting inconvenience that follows such practice, due to the unbalancing of the line and can now overcome entirely that objection and use a welder of the new type in the same manner as any other multiphase apparatus is used.

CUTTING HEAVY RISERS AND SHAFTS.

Dr. A. Krebs, Consulting Engineer, Boston.

Thicknesses of 8-inch and more can be classed as heavy cutting and special equipment should be used. First of all a group of oxygen cylinders coupled with a first class oxygen regulator of large size is essential. Then it pays to use hydrogen instead of acetylene whenever it is handy. Finally the cutting torch has to be well designed and great care has to be taken that the proportion of hydrogen to oxygen is figured out correctly.

Hydrogen has to fill a double bill. It has to serve as a preheating gas and it has to act as a deoxydizing chemical to keep the slot clean. A correct proportion of oxygen and hydrogen makes the cutting of even the heaviest pieces easy —the torch just walks through.

Material	Square Inches	Total Oxygen	Time Min.
15-inch Riser	177	162	14.00
16-inch Shell	200	200	14.00
18-inch Shaft	254	250	16.00
20-inch Shaft	314	300	18.00

The pressures used for cutting these heavy thicknesses were 160 lbs. for the 20-inch cut and 100 lbs. for the 15-inch cut.

Mr. W. L. Harris, formerly with the Thermalene Co., is with the Burdett Oxygen Co., at Seattle, as manager.

Over Here!

Say, you red-blooded fellow Over Here, take down the receiver and listen to a line of talk that ought to get under the hide and into the heart of men of your brand.

You are a skilled man. You have been fighting life's game in a country where every man has an even chance to make the most of himself. You are an American, and all that you are, and all that you hope to be, reflects to the credit of a democracy.

That democracy is being assailed by the most damnable foe that ever fired a cannon, that ever drove home a bayonet, that ever ravaged a neutral state, that ever sunk a hospital ship, that ever shelled women and children in lifeboats, that ever crucified and castrated captured enemy soldiers, that ever cut the right hands off boy children in captured territory, that ever raped women by the thousand, that ever lived to fasten its demon clutches on the throat of civilization.

Almighty God will not permit the unleashed hellishness of Kaiserism to engulf the world. No sane thinking man can conceive of an all wise and all loving supreme Deity permitting our secton of the world to become under German leadership—the stench of the universe, but now, not tomorrow —right now—Almighty God needs the help of trained men.

It has been said repeatedly by men who ought to know what they are talking about, that this war will be won in the air. Uncle Sam is building an air fleet that will astound the fighting world. Factories from Maine to California are working day and night on aeroplane parts. Guns and oil and gasoline and cameras and other material parts of these war machines are coming along as fast as skilled organized American factories can bring them out. Already they are being assembled, and that acme of the American get-together spirit, The Liberty motor, is being installed.

Ever since this great war started the government has been establishing aviation schools to perfect the bird men who will be the eyes of the national army. These schools have already turned out a mighty healthy number of those fearless chaps who can climb to dizzy heights, loop the loop, spiral with the engine cut off, repair a jammed machine gun and get it into action before they reach the ground, and there are thousands more well on the road to their commissions, and they are getting into the seats of the new machines almost before the paint is dry on the initials U. S. A.

The machines and many of the fliers are taken care of, but there is a crying need of trained men to care for these machines, and those men will be forthcoming when the need is known.

There is a blank at the bottom of this page that when properly filled out will make a glorious chapter in the history of this country. It will be the answer of skilled gentlemen to the challenge of skilled brutes.

But let's get down to cases. Do you drive an automobile? Thank God, if you do and sign the blank.

Do you know anything about a gasoline engine? Thank God, if you do and plaster your name on the blank.

Are you a machinist or a machinist's helper? Thank God that your time in the land of the free has been spent learning a useful trade, and put your signature to the blank, firm and right in your conviction that it is the greatest act of your life.

Do you know skilled men, and have you any influence with them? If you have, put that influence to work, put your shoulder to the wheel, remind yourself that war is now the business of America and that we are threatened with all those things Germany has taught the world to expect from her. Spot your skilled men, and if they are not working on war essentials, shoot some of your brand of Americanism into them.

Men of draft age, if these remarks reach you, reach for your hat and start for the nearest recruiting station and enlist in the aviation section of the Signal Corps. You can't enlist after December 15.

If you are 18, 19 or 20 years old sign the blank and become a man.

If you are between 32 and 40 years of age and qualified, sign the blank and put your name where it belongs, among those who know no obligation greater than their love of country.

There has never been a greater appeal to skilled men. There probably will never be a greater need of skilled men called upon to perform a duty so essential.

In God's name, you skilled men, recognize this emergency. Know a need when you see one. Discern between German made news and American made news. This is no six months' war. It is a fight between principle and despotism, and it is a finish fight.

Uncle Sam needs skilled men. He puts his need up to you. In humanity's name, sign this blank with a hand that doesn't shake. It's an opening for a body blow at Autocracy.

Here is a List of the Kind of Men Wanted

(Arranged in the order of number of men needed)

Chauffeurs
Auto Mechanicians
Automobile Engine Repair Men
Office Clerks
Carpenters
Radio Operators
Electricians
Instrument Repair Men
Cooks
Coppersmiths
Armorers (Machine Gun Repair Men)
Sail Makers
Photographers
Machinists
Blacksmiths
Motorcycle Repair Men
Stenographers
Cabinet Makers
Draftsmen (Mechanical)
Magneto Repair Men
Metal Workers
Automobile Engine Testers
Rope Riggers (Cordage Workers
Propeller Makers (Airplane)
Riggers (Airplane Assemblers)
Telephone Linesmen
Tool Makers
Vulcanizers
Welders
Lithographers
Packers
Telephone Operators
Motorcyclists
Plumbers
Painters
Tailors
Gas Works Employees
Buglers
Moulders
Pattern Makers
Telephone Adjusters
Barbers
Truck Masters
Brick Layers
Cobblers
Propeller Testers (Airplane)
Boat Builders
Saddlers
Stock Keepers (Experts)

Just Fill In, Cut Off and Mail One of These Slips

Volunteer Department, 119 D Street, N. E., Washington, D. C.

I desire to enlist, as a skilled workman, in the Aviation Section of the Signal Corps.

Name ..... Age.....

Address .....

At present employed with.....

.....

Trade ..... No. yrs. in trade.....

IDEAL FACE SHIELD FOR ELECTRIC WELDERS.

Since electric welding is achieving such gratifying results, an increasing need has been felt for an operator's shield that would be a real protection for the eyes and face and at the same time permit the free movement of the head and arms of the operator. Several employees of the P. C. C. & St. L. R. R. shops at Columbus, Ohio, have developed and perfected such a shield. It has been given the most thorough and exacting service tests, and the results more than justify all the claims made for it. The shield is light in weight as it is constructed of aluminum and vulcanized fibre, and by a clever arrangement is supported entirely upon the head of the operator. Another excellent feature is the ease with which the operator can open and close the door

containing the colored glasses, thus making it convenient for him to examine his work without removing the shield. When the door is thus opened there is still a clear glass which protects the eyes from any flying particles. In addition to these points, the ingenious construction of the shield prevents the possibility of a glare or reflection from the side or rear and an apron of fireproof material protects the chest of the operator from his own arc. The shield is manufactured and sold by the Ideal Face Shield Company, 468 N. Garfield Ave., Columbus, Ohio.

OXYGEN GAS COMPANY BUILD NEW PLANT.

This company manufctures commercial oxygen gas, which is used for the welding and cutting of metals; hydrogen gas, which is employed similarly and especially in the manufacture of synthetic chemicals; nitrous oxid gas, which is used as an anesthetic and is rapidly replacing chloroform and ether; and medicinal oxygen.

The company also stocks a complete line of equipment for use with the different products, and willmaintain a day and night service at both of its Kansas City plants.

This company now has over $100,000 invested in equipment, having grown from a very modest beginning in 1913. The officers of the company are as follows: Mr. John R. Foran, president; Mr. Wm. H. Ehlers, vice-president and treasurer; Mr. Parker B. Francis, secretary; Mr. E. N. Stevens, engineer; Mr. John T. Harding, counsel.

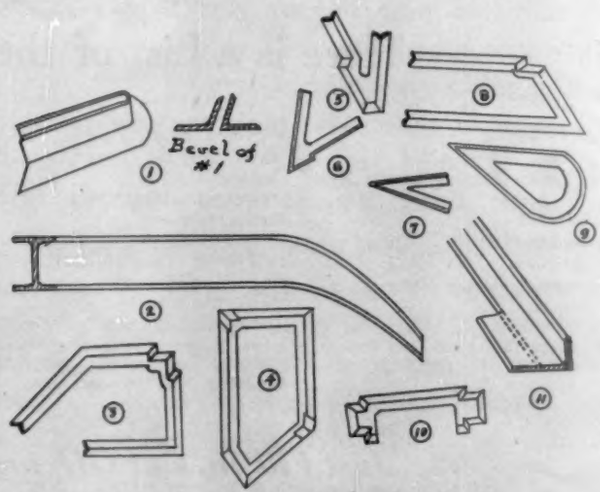
THE ELECTRIC ARC IN THE SHIPYARD

By D. B. Truitt

There seems to be no appreciation of the merits of the electric arc in the shipyards in this country and what little work there is being done at present is nothing compared to what really can be done. It lacks intelligent application, for there are thousands of pieces that can be successfully done with the arc. But shipbuilders have not grasped the wonderful merits of electricity as a welding medium, simply because the ones capable of demonstrating its possibilities have been asleep and were letting the opportunity slip through their fingers.

It is surprising how little the average shipbuilder knows of this system of welding. When you mention electric welding to him, he conjures in his mind a vision of the crude methods that are being used in some steel foundries; that is, boiling water barrels and immense tin hand shields, and using boiler plate punchings for filling material. He does not know of the wonderful strides this branch of welding has taken in the past few years, nor of the skilled welders who are welding everything in steel from delicate instruments to one piece cars, and gas welders who can weld most every metal or alloy. He knows nothing about the spot welding machines that are automatic and capable of making thousands of welds a day.

Now that we are in this world war we should increase our production and at the same time, use as few workmen as possible by installing time and labor-saving devices. And let me state that autogenous welding, as it is being done today, is a big saving, both in time and money, over the



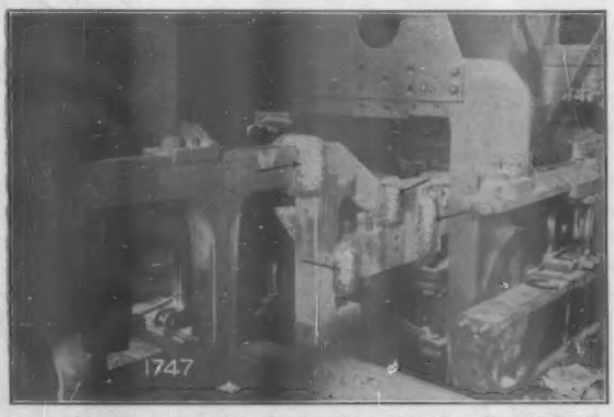
methods used by most of the shipyards today. Here is one use to which the electric arc can be put: The steel foundries are working at full capacity now due to war orders, yet the shipbuilders are sending back defective castings to them to be welded. The cars they are using in transporting these castings backward and forward, should be at the service of the government for the transportation of munitions for our men and our allies who are fighting for us.

Due to a shortage in rolling stock he does not get his castings back as quickly as he would like and the delay costs him money. Now if he is equipped for welding he can repair the castings at his own plant and not interfere with shipments of munitions and charge the expense against the steel foundry.

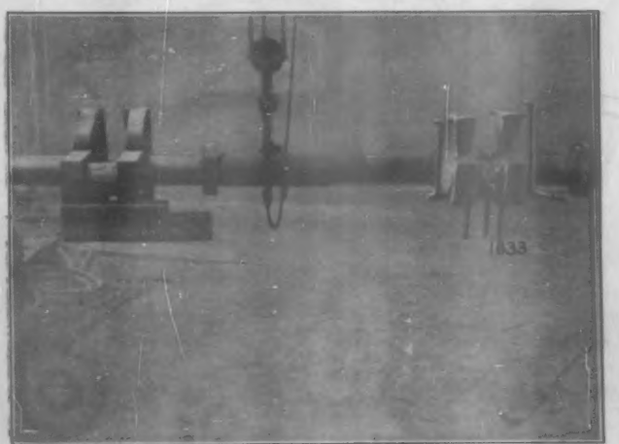
Not only in welding is the shipyard losing money, but in their antique methods of cutting plates, angles, etc. The writer has seen four men on one set of shears working a whole day cutting plates and angles, and the work that they accomplished could have been done in about two hours by a skilled oxy-acetylene operator with a good torch. Rivet

New neck cast on to large roll made with the aid of Thermit and having the pods cast in at the same time.

Large bevel gear on which two new teeth and crack have been repaired.



Four Thermit welds on locomotive frame on the Missouri Pacific Railroad, made without removing the frame from place.



New crank pin welded in by the Thermit Process.

Thermit Does the Heavy Welding and Does It Right

The Thermit Welding Process is the only one that is best adapted to repairing of heavy sections (see illustrations).

Thermit will repair such sections quickly and economically. Many serious delays have been avoided from the use of Thermit Welding and saved thousands of dollars in time and expense.

If you have a breakdown

wire or telephone our nearest office and we will proceed at once for arranging the shipment of materials and send an expert to supervise the repair.

We have an eighty-page pamphlet devoted exclusively to this class of work, which is known as pamphlet No. 1779, and tells how the work is executed and how you can do the work yourselves.

Goldschmidt Thermit Co.

Equitable Bldg., 120 Broadway
New York

329 Folsom Street, San Francisco 7300 South Chicago Avenue, Chicago
103 Richmond Street, W., Toronto, Ont.

heads can be cut off with oxy-acetylene also, at approximately 75 cents per hundred.

Below I am giving a few sketches of frames, staples, etc., that are used in ship construction, and in these modern times are made almost entirely by anglesmiths. Fig. 1 shows a very difficult job for the anglesmith because of the bevel of the angles and of course he gets a good price for a job like this. Now this job can be made in three pieces and electric welded for a few cents. Fig. 2 is a boat davit made from an 8-inch I beam, the web is split, closed in and welded. This, also, is a very difficult job and the anglesmith usually gets from $6 to $7 for a job like that, and does not like them even at that price. Now these can be welded for $1 with the electric arc.

All of these pieces shown here can be welded and are being welded in some places.

Some seem to think that welds of this kind are not reliable, but if the two main factors are considered there will be no failures. The main factors are: Operator and filling material. Welds on angle frames like sketches shown above should never be attempted with the carbon arc unless the operator is skilled in carbon arc welding. The average carbon arc welder should not attempt them because of the many things to be considered. The writer once in experimenting with manganese steel, made a wire electrode that would leave a heavy slag when melted in an effort to exclude oxides.

It was made as follows: Take a piece of ⅜ wire about 15 inches long, lay a piece of aluminum wire of about 28 gauge for full length, then wrap the entire length with asbestos cord and let soak in a saturated solution of borax, then place it where it could dry. In using a slag electrode, the steel bath conditions are duplicated. The results obtained were satisfactory.

They are too troublesome to make by hand and similar electrodes are on the market today and can be bought reasonable and it hardly pays to make them yourself.

They are fine for soft metal welds as well as for manganese steel. I would advise that welders would try a slag electrode sometime, and see if they get as good results as the writer has. I would like to urge all who are interested in welding to put their shoulder to the wheel, and do their bit for there will never be another chance like the present to push autogenous welding to the front.

OXY-ACETYLENE STEEL CUTTING

(Continued from page 26)

facture, and being that armor plate is of such enormous size and weight, that the surface cut is exposed to such local and intense heat, and its radiation checked by the overwhelming bulk of cold metal is one of the reasons for this extreme hardness.

Next to acetylene, hydrogen is the most extensively used gas in connection with oxygen. In the cutting of armor plate it is used exclusively. Its advantage over the acetylene flame in the cutting of this class of steel and of mild steel of extra heavy thickness lies in the fact that the flame is of greater length and diameter, which serves to heat the cutting line to a far greater depth, enabling the cutting oxygen to perform its action more fully. The hydrogen flame being of greater volume is not as hot as the acetylene flame which is concentrated into a small bluish cone.

The use of hydrogen as a fuel gas is confined however to the cutting of these heavy steels. In the cutting of steel for general construction purposes acetylene is used universally, it being the safest and more economical, and produced on a more staple commercial basis. Other gases have also been introduced on the market with claims for exceptional merits, consumers apparently being content with the results obtained by the use of the two gases chiefly dealt with.

Excessive Costs

The loss to manufacturers due to existing conditions can be imagined when one considers the quantity of gases which are wantonly wasted in present day practice. Exact figures could be given of this tremendous loss in many particular instances. Suffice it to say however that it is costing manufacturers for material, labor, etc., as high as twelve dollars per eight-hour day for many operators under their employ, to cut steel ranging from one-eighth to five-eighths in thickness. Costs vary as is understood according to the ability of the operator. Many operators will cut this same day's work with an expense of ten dollars. A skilful operator will cut the cost to six dollars and turn out a better quality of work. Quite a contrast in costs, but they are unexaggerated, and it is the only clear way of presenting the difference.

Tables of consumption rates of gases and costs have been published by many authorities, but to what degree have they been consulted in actual practice? Because gases cannot be seen does not decrease their material value. They are costly and must be treated in the same manner as material of a more conceivable form.

A FEW TOPICS OF INTEREST.

By Dr. A. Krebs, Consulting Engineer.*

I.

The writer's attention was called the other day to a seemingly wonderful demonstration. A representative of a concern went around to several junk shops where they do cutting on a large scale and asked permission to cut a little with his own torch and with one of their acetylene tanks which had already been put aside as empty. Of course everyone wanted to see this stunt and so he rigged everything up and in fact cut for some time with the empty tank. Then he explaned that his torch was built according to the injector principle and that everything that he took out of the empty tank was net profit to the junk man.

Of course I could not explain to the people that the injector torch uses up more oxygen than a pressure torch or refer them to the extensive explanations given in Granon & Rosenberg's French book, "Soudure Autogene" about this item. But I could at least make them understand that in order to suck the acetylene out of the tank, some power had to be used and that they could easily find that they would use more oxygen, as part of it was necessary to do this sucking work. They were wise enough to understand that in this world one does not get something for nothing and wherever some work has to be done, power in some form or other has to be consumed.

An extensive test, cutting out a number of similar boilers partly with the pressure torch, partly with the injector torch, proved easily that the injector principle may be a necessity when using low pressure generators, but that it cannot show up where compressed gases are used.

We did not make tests about how much acetone was drawn out of the tanks with emptying the tanks to the last drop of acetylene, because the junk dealers were not interested in this item, as they did not have to pay for it.

II.

There is some talk going around that electrolytic oxygen is more dangerous than liquid air oxygen, because the former might contain hydrogen up to the danger point. Modern electrolytic plants take great pains to manufacture oxygen of at least 99% purity and watch it continuously, because if something should blow up, it would be in the first instance, their own plant during the generation or at least when they compress it into cylinders.

*General Welding & Equipment Co., Boston.

BURDETT OXYGEN COMPANY

AND ASSOCIATED COMPANIES

ELECTROLYTIC OXYGEN and HYDROGEN - 99 1/2 % Pure

Service from the following BURDETT PLANTS

Los Angeles, Cal.
Salt Lake City, Utah
Denver, Colorado
Oklahoma City, Oklahoma
Fort Worth, Texas
St. Louis, Mo.
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Logansport, Ind.
Chattanooga, Tenn.
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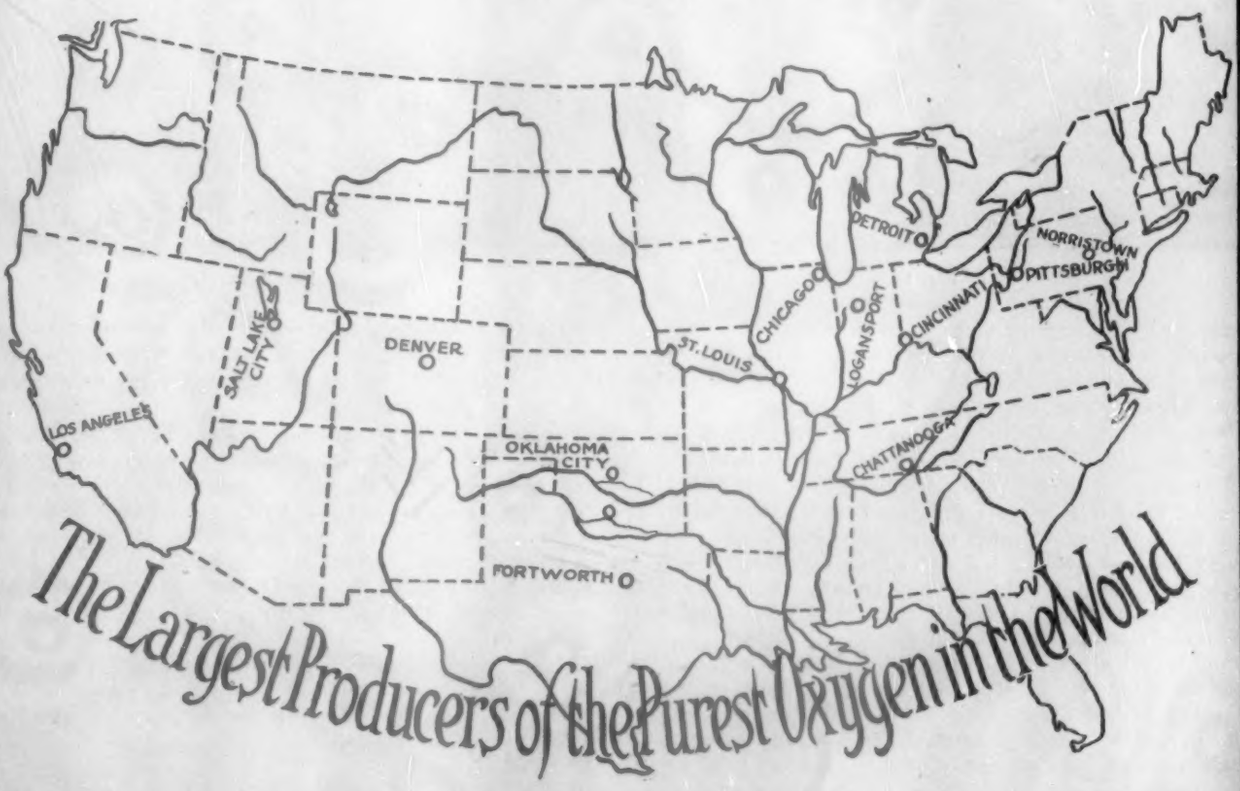
Norristown, Pa.
Chicago, Illinois



The Largest Producers of the Purest Oxygen in the World

WOMEN IN AIRPLANE PRODUCTION.

It is no secret that all belligerents in the world war are engaged as actively as circumstances permit in the production of flying machines of the heavier than air type. Great Britain herself has more than one thousand factories employed one way or another on this work and, according to the figures given recently by Dr. Addison while still minister of munitions, the output at the end of the current year in Great Britain alone will be more than six times what it was in the middle of 1916. In about the first five months of the year the number of work people employed in British airplane factories increased by 25 per cent., the increase being largely woman labor, for it was stated that the percentage of female labor has risen from 19 to 37.

The Schools for Women.

Great Britain has schools in which women are trained, and with the work simplified by subdivision of operations, there is no limit except physical strength to their employment. As recent exhibitions have shown, the work of the women ranges over the whole of aircraft, from the production of cylinders and machined parts for Clerget, Hispano Suiza, Le Rhone, Gnome and other engines to the metal and wood parts and the assembling and testing of the planes themselves. Except possibly as regard machining and plain assembling operations, the time required to perform operations cannot readily be stated, but the series of illustrations here offered will give a fairly good idea of the work of women directly on aircraft construction. Special mention may perhaps be made of the use by women of the carpenters' jack plane for planing up struts, the truing up of tie-rods on planes and the finish-shaping of propellers. The illustrations are from photographs taken in factories in various districts of England and were courteously provided by the labor-supply department of the Ministry of Munitions. * * * * * *

Fig. 1

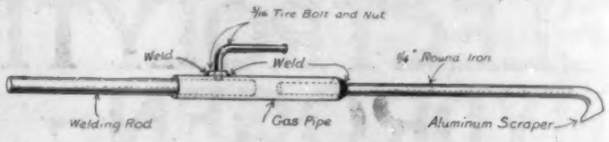
Fig. 2

Much coppersmithing, tinsmithing and similar work is undertaken by them. They braze nipples and cocks into pipes. They test pressure gages and tanks; they draw copper tubing; they cut sheet metal with shears, and they do every kind of welding for aircraft, in many cases without male help, while in some instances only one man is retained for the heavier work. Oxyacetylene welding, including aluminum and electric welding, is of course undertaken, and Figs. 1 and 2 give views of women engaged in this kind of work. In Fig. 1, for example, they are shown welding metal sockets; Fig. 2 shows women welding exhaust manifolds for airplane engines. About three weeks of training is needed for such work as oxyacetylene welding the pipes used on silencers.

The operations undertaken on metal parts of aircraft thus include laying out, filing, drilling, welding, brazing, tinning, blanking, bending, riveting, threading, tapping, turning, fitting bolts and nuts, assembling, sand-blasting, painting and enameling.—*American Machinist.*

HOLDER FOR WELDING RODS

Editor: Enclosed find a sketch of a rod holder which will enable the welder to use his cast steel, bronze and other materials to better advantage, only abut ½ inch being wasted. I have about 40 of them at my bench all the time and always keep them



filled up ready for the next job. I have always used the puddle system on aluminum and the other end of the holder may be used as a scraper or puddler by flattening or bending the end. The sketch will illustrate. C. S. Johnston.

BRAZING A BAND SAW.

Editor: Enclosed please find sketch of a so-called holder and a pair of tongs used for brazing band-saws, which I would be pleased to have put in The Welding Engineer some time, besides a little explanation. Hope you will get the idea from my sketch, A being front, B a cross section, BB a rib rivetted on as a support and providing means of fastening the holder in a vise, C a pair of tongs made with heavy jaws which, heated up to a bright red color, is used to melt the joint together. P. Paulson.

Answer: How to braze a band-saw with the acetylene welding torch might interest many a welder, especially the less experienced. Make up a jig something like sketch, fasten it in a vise, cut the saw 1 inch longer than you want it while brazed, grind off one end of the saw about one-half inch in length, and about half the thickness of the blade—this on both ends of the saw so that the ground sides come together while pulling it in the jig for brazing. Take two pieces of German silver big enough to cover the ground part, put in between the joint is to be and a little brazing powder in between the ends that are to be brazed, and have a pair of tongs (like those in the sketch) with jaws about 1 inch in thickness, ¾ inch wide and about three inches long. Heat the jaws up with a torch to a bright red color, take hold of the joint is to be and squeeze it hard for about five seconds and your joint is made and, after

Ampco Bronze Welding Rods

The First Known Universal Welding Material

AMPCO BRONZE is known to the trade as the only bronze metal in the world possessing a greater strength than steel. It is also an acid resisting metal and is the very best bearing metal.

For the uses of the welder it is much superior to any other bronze welding material. It is also much safer and healthier to use as it does not throw off any fumes in welding as other bronzes. With the aid of AMPCO BRONZE WELDING RODS the welder may turn out welds of greater strength and with various metals than heretofore obtainable. Welding copper, bronze, cast iron, malleable iron and steel.

MR. KOPFERSCHMIDT, Master Welder of the Michigan Central Railroad, and a regular contributor to The Welding Engineer, says:

"With the aid of Ampco Bronze welding rods, bronze bearings can be repaired to a good advantage. Worn spots can be built up, giving a very hard surface. All sorts of bronze and brass castings can be welded with Ampco. In fact, broken brass, bronze or malleable castings can be welded with Ampco Bronze rod better than with Tobin bronze, or other bronze welding rods. I will gladly recommend Ampco to other welders. B. KOPFERSCHMIDT."

AMPCO BRONZE WELDING RODS are no more expensive than ordinary bronze rods, furthermore, Ampco Bronze is 20% lighter in weight than any other bronze in the market. We want you to try Ampco Bronze Welding Rods. Write for trial order and prices.

We recommend using only our Ampco Welding Flux in Welding with our Ampco Bronze Welding metal.

Ampco Rolling Mills Corporation

408 Security Building **Milwaukee, Wis.**

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OXY-ACETYLENE APPARATUS

WELDERS

MANUFACTURERS

of

Welding and Cutting Apparatus, Acetylene Generators, Lead Burning, Platinum Melting and Carbon Cleaning Outfits.

Gas and Oil Preheating Torches and Welding Fluxes, Rods, etc.

Write for Catalog.

Henderson-Willis Welding & Cutting Co.

2305-7-9 N. 11th St.
St. Louis, Mo.

Here's Protection Against Interrupted Gas Supply

With your own equipment of the new **I. O. C. Type 4-1000 Unit Generators**, you'll get not only the purest, most efficient gases at a saving of 60% in costs; you'll get also an uninterrupted supply of these gases, under your own control, ample for your needs, always available.

You'll be free from the delays and losses which so often follow interruptions in the supply of gas in cylinders.

You'll be independent—you'll always be sure of speed and efficiency in your operations using gas.

Write for the Type 4-1000 Bulletin

International Oxygen Co.

115 Broadway, New York

London;—Arthur Lyon & Wrench, Ltd., Caxton House, S.W.

Efficient Preheating

Every experienced welder knows that the secret of success in welding is in preheating properly. Charcoal is expensive and slow. Most jobs can be handled more satisfactorily with a Vulcan oil burning preheating torch. The Vulcan weighs but 25 pounds and burns in any position. It gives a roaring flame, 24 inches long. The Vulcan is in use in welding shops everywhere. Write for booklet.

Alger Supply Company

Peoples Gas Bldg., Chicago, Ill.

THERMALENE — THE GAS OF GREATEST EFFICIENCY — THERMALENE

The Oxy-Thermalene Method

of Welding, Cutting, Brazing, Etc.

The only Acetylene Oil Gas Producer in the world. Saves 25% on gas and oxygen. First class references.

Thermalene gas in conjunction with Oxygen gas produces the ideal flame for welding and cutting.

There is no loss of time due to shortage of gas. The Producer works only when you work. When shut off, Producer ceases instantly.

Thermaline will not produce faulty welds due to impure and moist gas. The Producer may be mounted on a truck and made portable.

Thermaline Gas, being heavier and richer than Acetylene and other gases, has more body, producing a softer non-oxidizing flame, which assures a more uniform weld and a cleaner cut, without burning or making the metal brittle.

Write for full information, catalog and prices.

THE THERMALENE COMPANY

Chicago Heights, Ill.

We Will Sell Patent Outright for England, Canada, France, etc.

A Special Torch for Canadians

This new welding torch is the product of years of experience. It is made of the very best material by thorough mechanics. It is nicely balanced and dependable in every respect. This torch gives a perfect gas mixture, possesses the non-flash quality and is economical in operation.

This new torch is not an experiment— it has been in constant use in our own shops for many months and gives perfect satisfaction. Because we are manufacturing these torches in large quantities we can sell them at the low price of $10.00. Our guarantee of perfect satisfaction is included. Write for details.

Welding and Cutting Appliances and Accessories, Oxygen and Acetylene.

$10

Compressed Gas Company, Limited

Welding and Cutting Engineers

572 Howe St. Vancouver, B. C.

$10

FREE SAMPLE OF FLUX

WELD TRADE A MARK CAST

A SUPERIOR FLUX FOR

OXY-ACETYLENE WELDING

"WELD-A-CAST" Flux No. 1 for Welding Cast Iron.

"WELD-A-CAST" Flux No. 3 for Welding Brass, Bronze, High Speed Steel and all High Carbon Steel.

Eliminates pin holes and blow holes, leaving the metal soft.

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Cortland Welding Compound Co. CORTLAND N. Y.

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Anti-Borax Welding Fluxes

Our Brazing and Welding Fluxes for Cast Iron, Brass, Aluminum and other metals are superior to any other. We guarantee them to give perfect satisfaction.

For sale by all jobbers or by

Anti-Borax Compound Co.

Fort Wayne, Indiana

Quotation from a Report of the United States Government.

Department of Commerce

Technologic Papers of the Bureau of Standards, No. 93

(Issued May 5, 1917)

Glasses for Protecting the Eyes from Injurious Radiations

By W. W. Coblentz, Associate Physicist, and W. B. Emerson, Laboratory Assistant

The Gold Plated Glass is the most effective means yet produced for shielding the eye from infra-red rays. Data are given showing that of the infra-red rays emitted by a furnace heated to 1000 and 1100° C. about 99 per cent are obstructed by Gold Plated Glass, about 60 to 80 per cent by very deep black glass, about 60 per cent by greenish yellow glass. Exposure to excess of ultra-violet light is injurious, causing conjunctivitis. Glasses having a gray or neutral tint are the most agreeable to wear, as they do not alter the color of objects.

Pfund Welders' Goggles

Pfund lenses are the latest improvement in glass for welders. They are made up of a combination of a strong, colorless optical lens and a lens of Sir William Crookes glass, with a thin film of 14K solid gold in between. A special process of fusing makes this combination of the three practically as solid as a single piece of glass, and of even greater blow-resisting qualities.

The clear glass side of the Pfund lens is worn on the outside, the Sir William Crookes side is worn next the eye. The film of gold acts as a reflector of the harmful infra-red or heat rays, and transmits less than 2 per cent. The Sir William Crookes glass does its work by shutting out the ultra-violet rays. A large per cent of the visual light in welding operation comes from the incandescent sodium gases of the flux used to prevent oxidation. The bright yellow light may be absorbed without a marked loss in the visual and allow what is known as "seeing through" the flame. This special property of a glass is covered by the Pfund lens.

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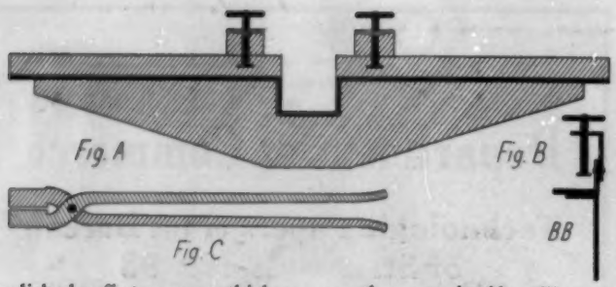

polished off to same thickness as the saw itself, will prove to be unbreakable.—Editor.

CUTTING A LARGE SHAFT.

The accompanying illustrations show Mr. C. Molas, Taft, Cal., cutting a 19-inch shaft. The cut was made in six

minutes, using a Burdett oxy-hydrogen torch, oxygen pressure of 190 pounds. The cut was made free hand.

WELDING SHEETS.

To weld sheets ¼x7x10 ft. bevel the edges to a 45 degree angle, and then separate the edges 1 in., as shown in the attached sketch. Start the welding operation at the close end, and continue without stopping until the extreme end is reached. At the end of the operation the two edges should meet exactly without overlapping.

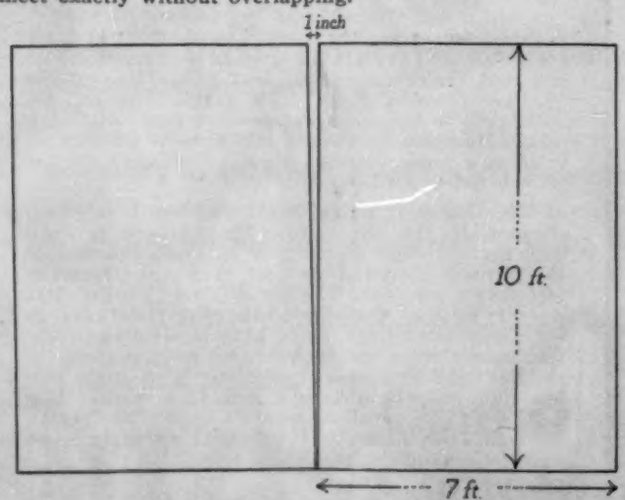

Fig. 1

It is of course very difficult to advise the distance which should be allowed in separating sheets of this character. The heat radiation and the character of the material being welded is apt to make a slight difference. If there is a considerable quantity of this work the welder should be able to determine a method of separating the sheets which would eliminate all trouble.

CARBIDE DRUMS.

Scattered over the country, particularly in lumber sections, are a number of concerns turning out floor sweeping compounds made from sawdust soaked in oil. These concerns are only too glad, we understand, to get hold of 25 and 100-pound carbide drums.

ELECTROLABS

"Electrolabs," or the Electrolytic Oxy-Hydrogen Laboratories, 15 Williams street, New York, N. Y., are marketing a new electrolytic oxy-hydrogen generator. Seven plants have been installed and several more are under construction. Mr. I. H. Levin, formerly chief engineer, and Mr. D. J. Tokonogy, formerly purchasing agent of the International Oxygen Co., are with the new company.

"PFUND" GOGGLES.

"Pfund" welders goggles, manufactured by William C. Adams, 332 Boylston street, Boston, Mass., are meeting with much success. Mr. Adams reports that welders are beginning to realize the importance of proper eye protection. Glasses that eliminate the ultra-violet ray are in demand, particularly a glass possessing the grey or neutral tint, which is characteristic of the "Pfund" glass.

BOOKS ON PREHEATING.

Booklets Nos. 94-W and 90-W, issued by the Hauck Mfg Co., 101 Eleventh street, Brooklyn, N. Y., contain information of value to the welder. No. 94-W relates to boiler and structural work, while No. 90-W tells about various ways of preheating at a lower cost. Welders will find these two books of value.

Mr. R. L. Browne, who for the past 15 years has been identified with the electrical and mechanical engineering profession, has recently become associated with the Sales Department of the Goldschmidt Thermit Co. in the capacity of Commercial Engineer, after having spent several months in the foundry of that company acquiring a practical knowledge of the Thermit process of welding.

Classified Ads

Help Wanted—25c per line, minimum 4 lines.
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Other Ads—50c per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

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Wanted—Acetylene generator for cash; 50 lbs. high pressure; must be bargain. General Machine & Tool Co., Casper, Wyo. 1t-Dec.

Wanted—A man thoroughly experienced in welding and cutting with oxy-acetylene; able to do first-class steel plant plate welding and having sufficient executive ability to look after two or three gangs of cutters. Give experience in detail. This position is in Nova Scotia, but steel plant men not liable to conscription. Address Mackenzie, care *The Welding Engineer*. 1t-Nov.

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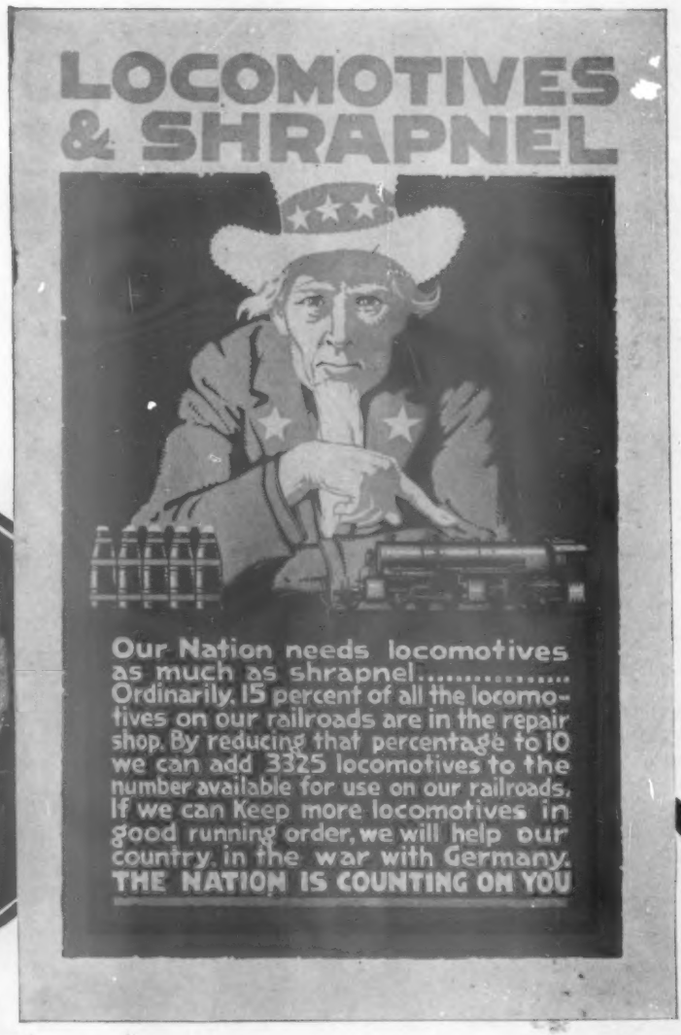
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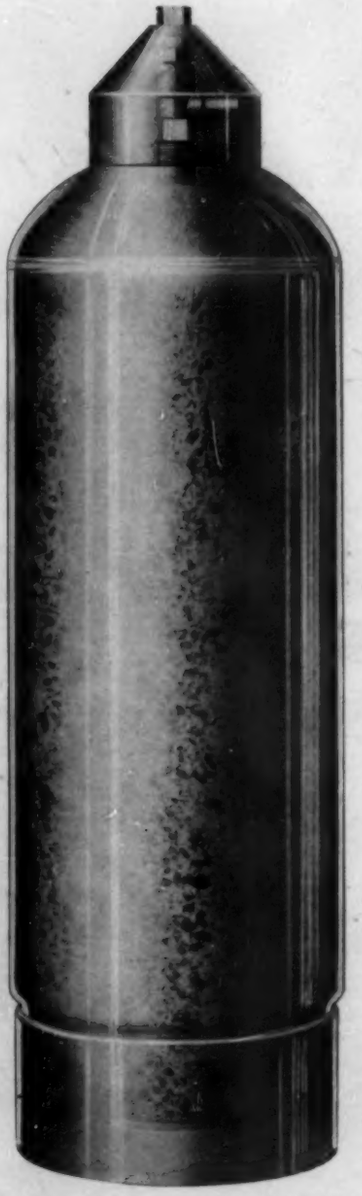
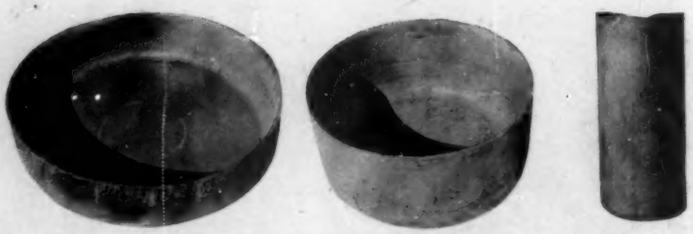


Forming the Shell



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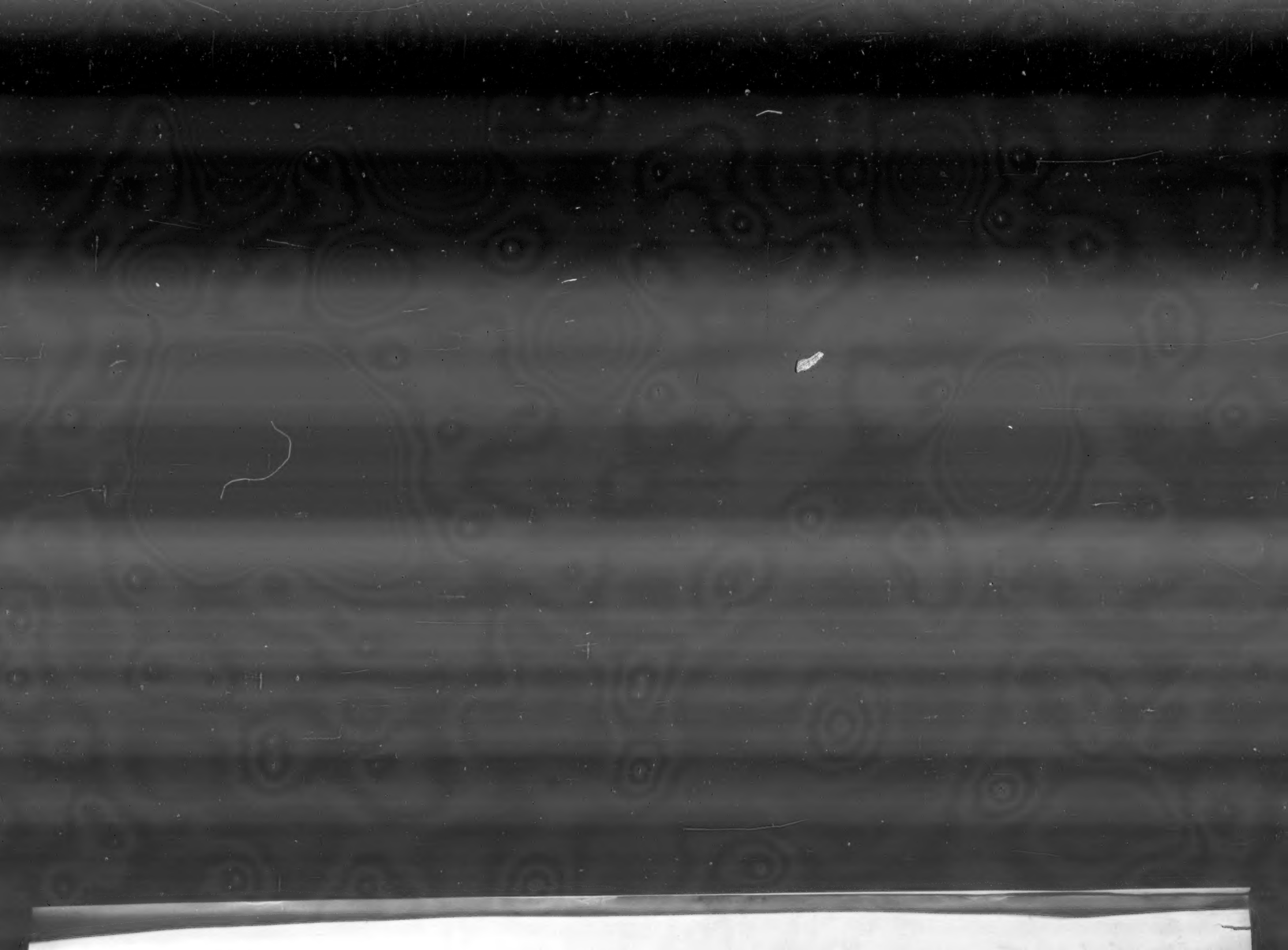
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